

NH DEPT OF
ENVIRONMENTAL SERVICES

SEP - 8 2008

RECEIVED

September 4, 2008

SEC/Terr Gas
DONALD J. PFUNDSTEIN
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Director

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Thomas S. Burack, Chairman
New Hampshire Site Evaluation Committee
29 Hazen Drive
P.O. Box 95
Concord, NH 03302-0095

**Re: Docket No. SEC 2008-02 - Application of Tennessee Gas Pipeline Company
For a Certificate of Site and Facility Concord Lateral Expansion Project**

Dear Chairman Burack:

Enclosed for filing on behalf of Tennessee Gas Pipeline Company (the "Company") is a copy of the Company's Response to Alteration of Terrain Permit Comments. These are the materials referenced in Attorney Michael Iacopino's Report of Pre-Hearing Conference (issued August 26, 2008) at page 2.

We have used the service list dated July 16, 2008, a copy of which is enclosed. Since we have no mailing address for Elizabeth Matthews, we have sent her copy via email.

If you have any questions, please have your staff call me.

Sincerely yours,


Donald J. Pfundstein

DJP/skr

Enclosure

cc: Service List
Elizabeth Matthews (email only)



SGC ENGINEERING, LLC

- Civil Design & Survey Engineering
- Environmental & Regulatory Permitting
- Electrical Power Systems Engineering

Offices - Westbrook & Orono, Maine

June 13, 2008

628001

Mr. Robert A. Tardif, P.E.
New Hampshire Department of Environmental Services
P.O. Box 95, 29 Hazen Drive
Concord, New Hampshire 03302-0095

RE: Response to Alteration of Terrain Permit Comments – Permit # 080422-05

Dear Mr. Tardif:

We are in receipt of a letter from you dated June 3, 2008 containing comments resulting from your review of the Alteration of Terrain Permit application for Tennessee Gas Pipeline's Concord Expansion Project in Pelham, New Hampshire. Mr. Nick Porell of our office discussed these comments with you via telephone on June 9, 2008 and subsequently with Ms. Amy Clark, P.E. of your office on June 10, 2008. We have summarized below the resolutions we understand to be acceptable and have attached revised plans, calculations and exhibits. For clarity, we have reiterated each of your comments followed by our response:

Alteration of Terrain Permit Comments

1. *Currently many of the post-development subcatchments are not hydrogeologically homogenous throughout and therefore should not be combined as one subcatchment. Please further subdivide such that the CN value used represents the land use, soils, and cover distributed uniformly throughout the subcatchment.*

The TR-55 stormwater modeling method allows for the use of a weighted curve number to account for a variety of surface types in a watershed. This is necessary in those instances where the flow pattern would otherwise require an overly cumbersome segregation of watersheds and complicated analysis. However, to address your concern further refinement of the watersheds has been completed where practical. As described in the Stormwater Management Report, the property has two distinct drainage sheds - Watershed 1S (tributary to Beaver Brook) and Watershed 2S (tributary to Industrial Park Road). For the Post-Development condition, Watershed 1S was subdivided into smaller watersheds 1S1, 1S2, and 1S3. Watersheds 1S1 and 1S2 represent the developed portion of the site tributary to Ponds 1P1 and 1P2 respectively. Watershed 1S3 represents what will remain the undeveloped portion of the watershed.

Watershed 1S1 is comprised of both undeveloped and impervious land cover and has been further subdivided for this revised analysis. The impervious surface includes of

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Target Technology Center, 20 Godfrey Drive, Suite 200, Orono, Maine 04473 • Office: 207-866-6571 • Fax: 207-866-6501

www.sgceng.com • E-mail: sgc@sgceng.com

a portion of the projects paved access road and parking generally found along the northerly limits of the watershed. Runoff from this impervious coverage generally sheets off the pavement and into the adjacent grassed swale prior to discharge into Pond 1P1. The undeveloped/landscaped portion of the watershed is generally situated in the southerly portion of the watershed with some area outside of the project property boundary. This portion of the watershed also drains to the grassed swale noted above prior to discharge to Pond 1P1. As such, Watershed 1S1 has been separated into Watershed 1S1A for the impervious portion and Watershed 1S1B for the pervious component. Similar time of concentration paths has been maintained from the previous model. The revised Stormwater Management Report and Watershed Plan reflect the revised watershed delineation. The increase in the runoff has been accounted for in the size and control structure for Pond 1P1.

Similar to Watershed 1S1, Watershed 1S2 contains both impervious and undeveloped/landscaped components. Unlike Watershed 1S1, the impervious components of Watershed 1S2 are not concentrated within one area of the watershed. The impervious area within Watershed 1S2 is comprised of paved roads and parking, gravel access, and compressor station facilities and components. The runoff flows across various surface types prior to reaching Pond 1P2. This watershed containing both pervious and impervious surfaces that are not arranged to drain independently is appropriately modeled as a single watershed. Therefore, due to the relatively small size of the watershed a weight average approach was concluded as being appropriate. No revisions to the delineation of Watershed 1S2 are included in the revised Stormwater Management Report.

2. *Pond 1P1 is not designed with an outlet other than the emergency spillway. As such, the HydroCad analysis must be performed with the water level in the pond at the spillway elevation (i.e., no storage in the pond).*

The SCS soils mapping and on-site test pits have confirmed the project site is predominated by highly permeable hydrologic soil group (HSG) A soils. The design previously submitted assumed stormwater would exfiltrate from the pond between storm events. The revisions to the modeling noted above in Comment 1 have resulted in greater inflow rates to Pond 1P1. As such, an outlet control structure similar to that of Pond 1P2 has been added to the design to attenuate the outflow from the pond rather than relying on the spillway restriction. This outlet control structure provides an orifice outlet at the base of the pond to allow for complete draining between storm events. It is still anticipated that some infiltration will occur within the pond though no infiltration is modeled. The project plans and Stormwater Management Report have been amended to incorporate this design revision.

3. *Please confirm that there is continuity between all proposed and existing contours. It appears that proposed contour 190 and 184 in the stone lined inlet swale leading into Pond 1P2 may be mis-labeled.*



The contour labels have been verified and revised to correct the mislabeling on Sheet 1.0.

4. *Please provide treatment for the roadway runoff from station 6+00 to the intersection with Industrial Park Drive. Stone check dams are not acceptable for adequate treatment as required by Ws 415.12 Permanent Methods for Protecting Water Quality.*

The design has been revised to incorporate the use of the roadside swale to provide adequate treatment in conformance with Ws 415.12. As described in the Project Description section of the Stormwater Management Summary, the project site is accessed via a 50-foot wide corridor containing an existing gravel road as well as an underground gas pipeline and water main. The applicant does not have land control outside this 50-foot wide corridor. As proposed, the existing gravel drive will be upgraded to pavement as part of the project. The improved road will generally follow the grades of the existing gravel drive sloping upward from Industrial Park Drive to Station 6+12.5. As noted, the previous design included check dams within the roadside swales to provide for some stormwater retention and treatment. To provide for additional treatment the road design has been revised to replace a crowned roadway with one using a consistent cross slope to the right (east) from STA 0+00 to 6+12.5. This will consolidate all roadway runoff in the roadside swale on the right side of the road. No swale will be provided on the left. This will eliminate the need to excavate a swale over the existing natural gas line that parallels the road. We have added Reach 2R1 to the Hydrocad model to analyze the flow conditions within the swale. The swale has been designed with a 2% grade from Station 1+50 to the intersection with Industrial Park Drive so that the flow conditions within the swale meet the maximum velocity and flow rate criteria for treatment swales outlined in Ws 415.12. Additional documentation and supporting hydrocad output is provided in the revised Stormwater Management Report. Sheet 2.0 has been revised accordingly.

5. *Please provide the 50-year AutoCad output for the proposed detention basins to verify whether they can safely handle the flows without overtopping.*

50-year runoff calculations are provided in the attached Stormwater Management Report. For Pond 1P1, approximately 0.88 feet of freeboard is available between the top of the pond berm and the peak water elevation for the 50-year storm event. Approximately 0.83 feet of freeboard is available in Pond 1P2 during the 50-year event.

6. *Runoff calculations were performed using the Type II storm. Pelham is located in the region of the state described by Type III storms. Please re-calculate using the Type III storm.*

The Hydrocad model has been re-calculated utilizing a Type III storm distribution. The revised output is included in the attached Stormwater Management Report.

A revised submittal package has been attached for review and approval. The package contains the following plans and documents:



Mr. Robert A Tardif, P.E.
June 13, 2008
Page 4 of 4

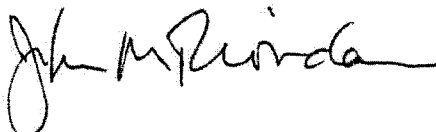
- Sheet 1.0 – Drainage and Grading Plan
- Sheet 2.0 – Entrance Road Plan and Profile
- Sheet 3.1, 3.2 – Details and Notes
- Sheet W.S.1 – Pre-Development Watershed Plan (not revised)
- Sheet W.S.2 – Post-Development Watershed Plan
- Stormwater Management Report

We will be pleased to address any questions or comments you may have. We anticipate that if our summary is consistent with your understanding of the agreed to resolutions a permit will be issued.

Thank you for your assistance.

Very truly yours,

SGC Engineering, LLC



John M. Riordan, P.E.
Director of Civil Engineering

enclosure

Cc: Harold McCracken
Charlie Malcolm
John Zimmer, P.E.



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ED FOR:
TENNESSEE GAS PIPELINE
1001 LOUISIANA AVENUE
HOUSTON, TEXAS 77002

SGC ENGINEERING, LLC
 • Civil Design & Survey Engineering
 • Environmental & Regulatory Permitting
 • Electrical Power Systems Engineering

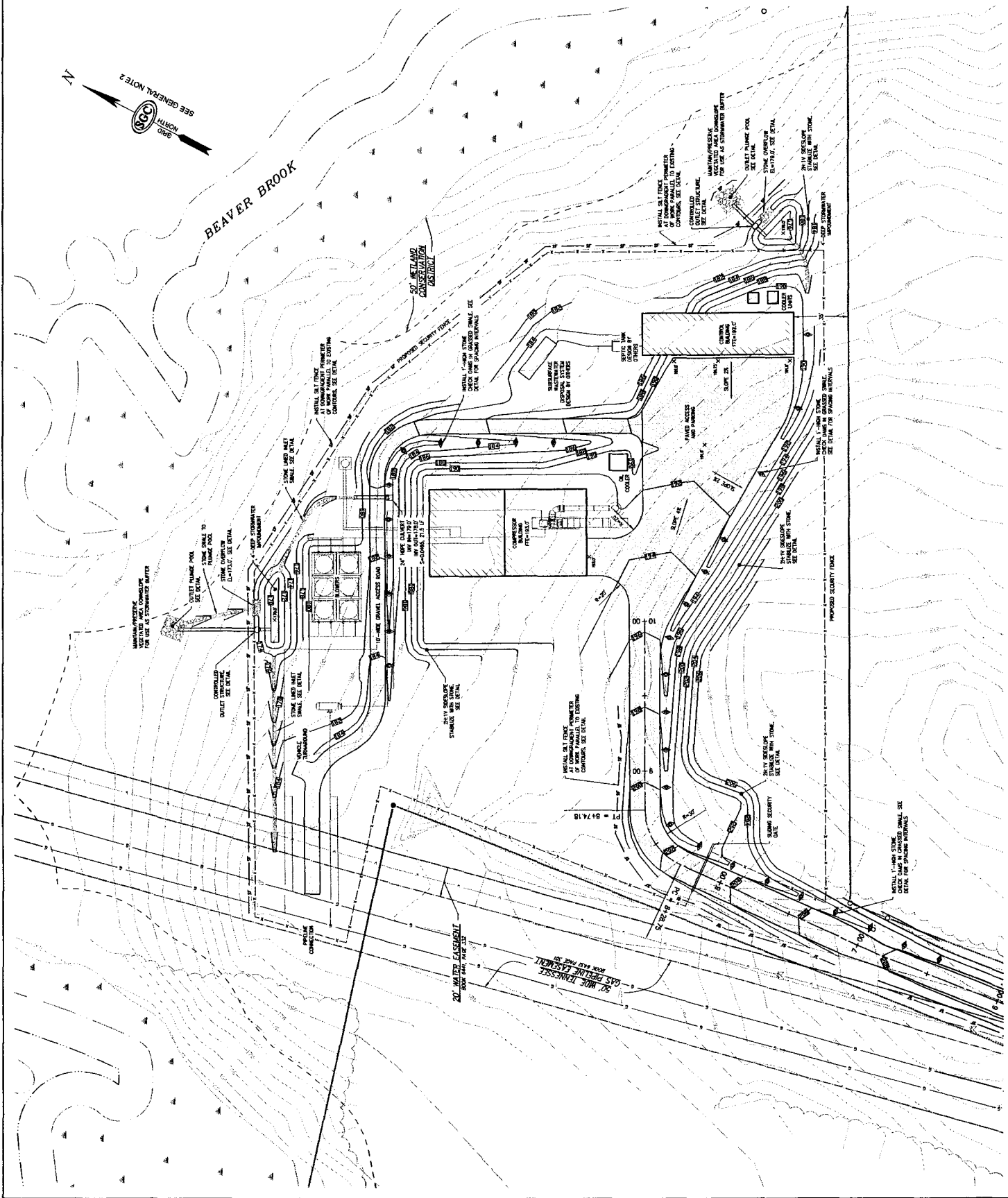
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- THE DAMAGE AND GRADING PLAN WAS PROVIDED BY SDC ENGINEERING, LLC PURSUANT TO A PROFESSIONAL SERVICES CONTRACT WITHEN EL PASO CORPORATION AND SDC ENGINEERING LLC DATED MARCH 19, 2008
- NORTH-SOUTH HIGHWAY IS GRID BASED ON DATUM YEAR 19, MAGNETIC US SURVEY FEET.
- ELEVATIONS SHOWN HEREON ARE REFERENCED TO HANCOCK US SURVEY FEET.
- EXISTING FEATURES SHOWN ON THIS PLAN ARE THE RESULT OF A FIELD SURVEY CONDUCTED BY SDC ENGINEERING, LLC ON JULY 17-20, 2007.
- MEADOWS SOUTH HIGHWAY WERE FIELD LOCATED ON JULY 17-20, 2007. THE AREA WITHIN FIFTY FEET OF THE DELINEATED MEADOWS SOUTH HIGHWAY ARE NOT TO BE USED FOR FILL OR CONSTRUCTION DISTRICT NO. 16

BOUNDARY, TOPOGRAPHIC AND PLANNETRIC MAPPING AS SHOWN ON THIS PLAN IS REFERENCED TO A PLAN ENTITLED "BOUNDARY AND TOPOGRAPHIC SURVEY OF PROPERTY LOCATED ON INDUSTRIAL PARK ROAD, PRELIM. HILLSBOROUGH COUNTY, NH, PREPARED BY D. J. PASO CORPORATION, 1000 HIGHWAY 1, S. DORCHESTER, MA, DATED 07/07/2007."

2. SITE LAYOUT OF GAS UTILITY BUILDINGS AND INFRASTRUCTURE BY D. J. PASO CORPORATION.

PRELIMINARY CIVIL DESIGN AND LAYOUT BY D. J. PASO CORPORATION.



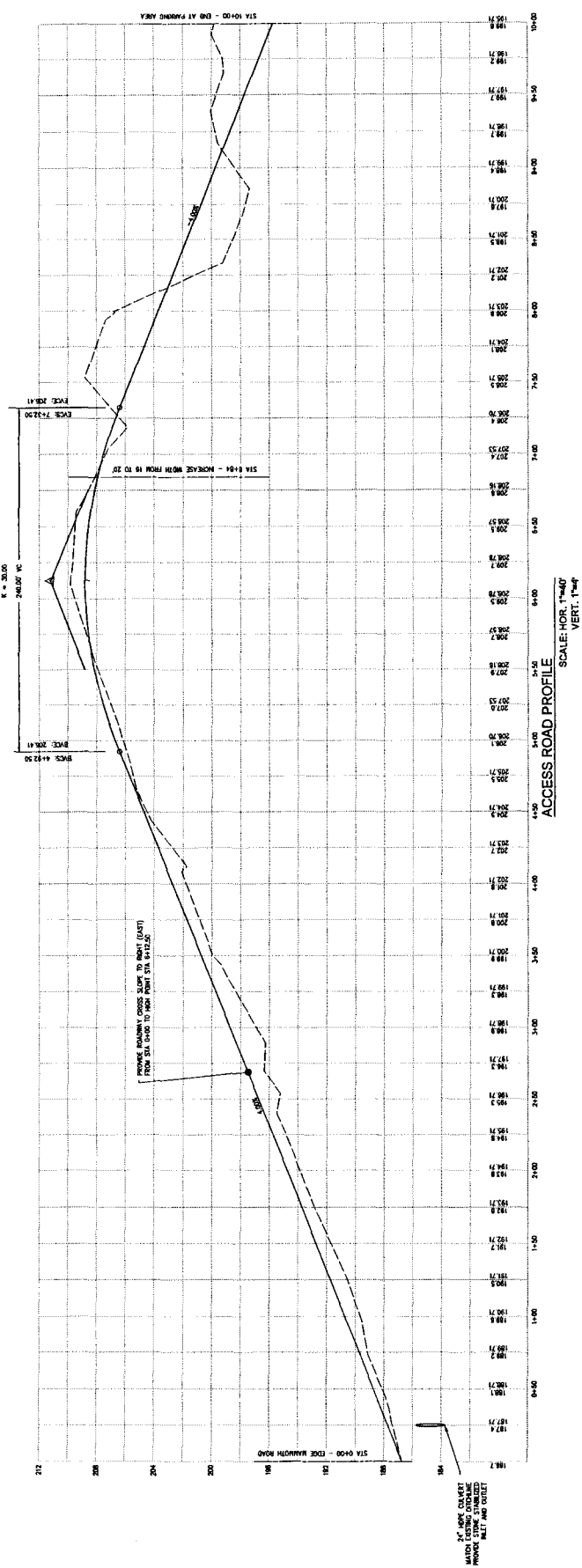
ENTRANCE ROAD PLAN AND PROFILE
COMPRESSOR STATION PROJECT
PELHAM, NEW HAMPSHIRE

TENNESSEE GAS PIPELINE
1001 LOUISIANA AVENUE
HOUSTON, TEXAS 77002

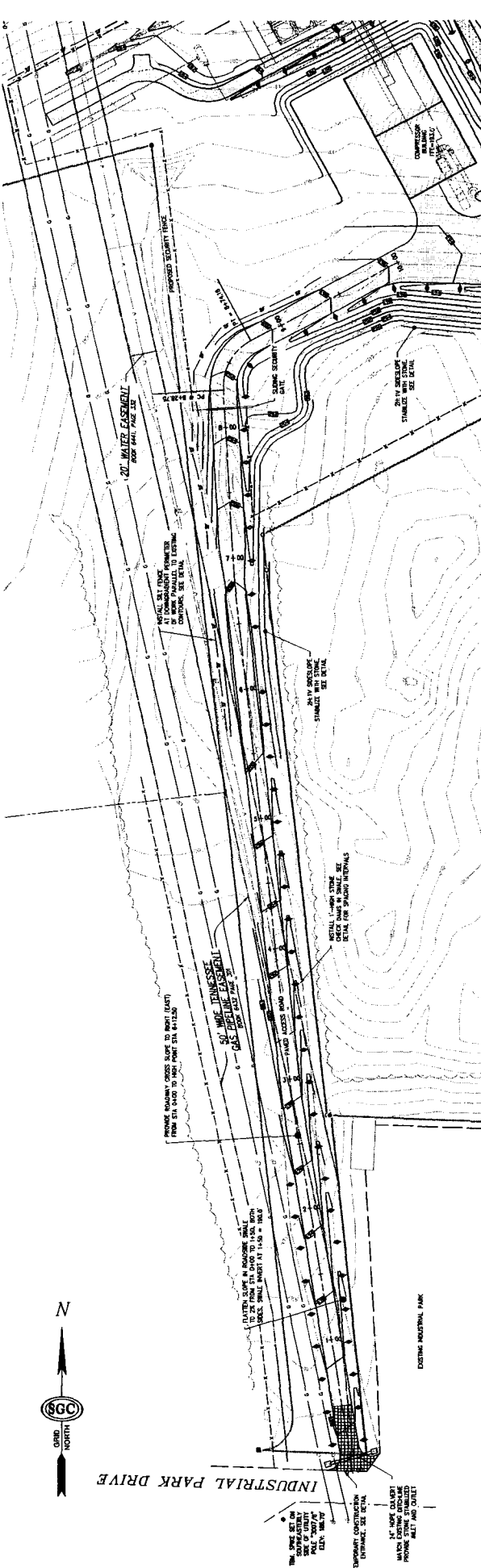


SGC ENGINEERING, LLC
Civil Design & Survey Engineering
Environmental & Regulatory Permitting
Electrical Power Systems Engineering

REVISIONS:
NO. DATE
1 06-26-2008
2 08-15-2008
3 08-15-2008
4 08-15-2008
5 08-15-2008
6 08-15-2008
7 08-15-2008
8 08-15-2008
9 08-15-2008
10 08-15-2008



ACCESS ROAD PLAN SCALE: 1"=40'



PRE-DEVELOPMENT WATERSHED

TENNESSEE GAS PIPELINE



PGC ENGINEERING, LLC
10000 Highway 100, Suite 100, Houston, Texas 77036
Tel: 281.465.1000 Fax: 281.465.1001
www.pgc-engineering.com

NO.	0
DATE	---

CLIENT REVIEW

1

CLIENT REVIEW

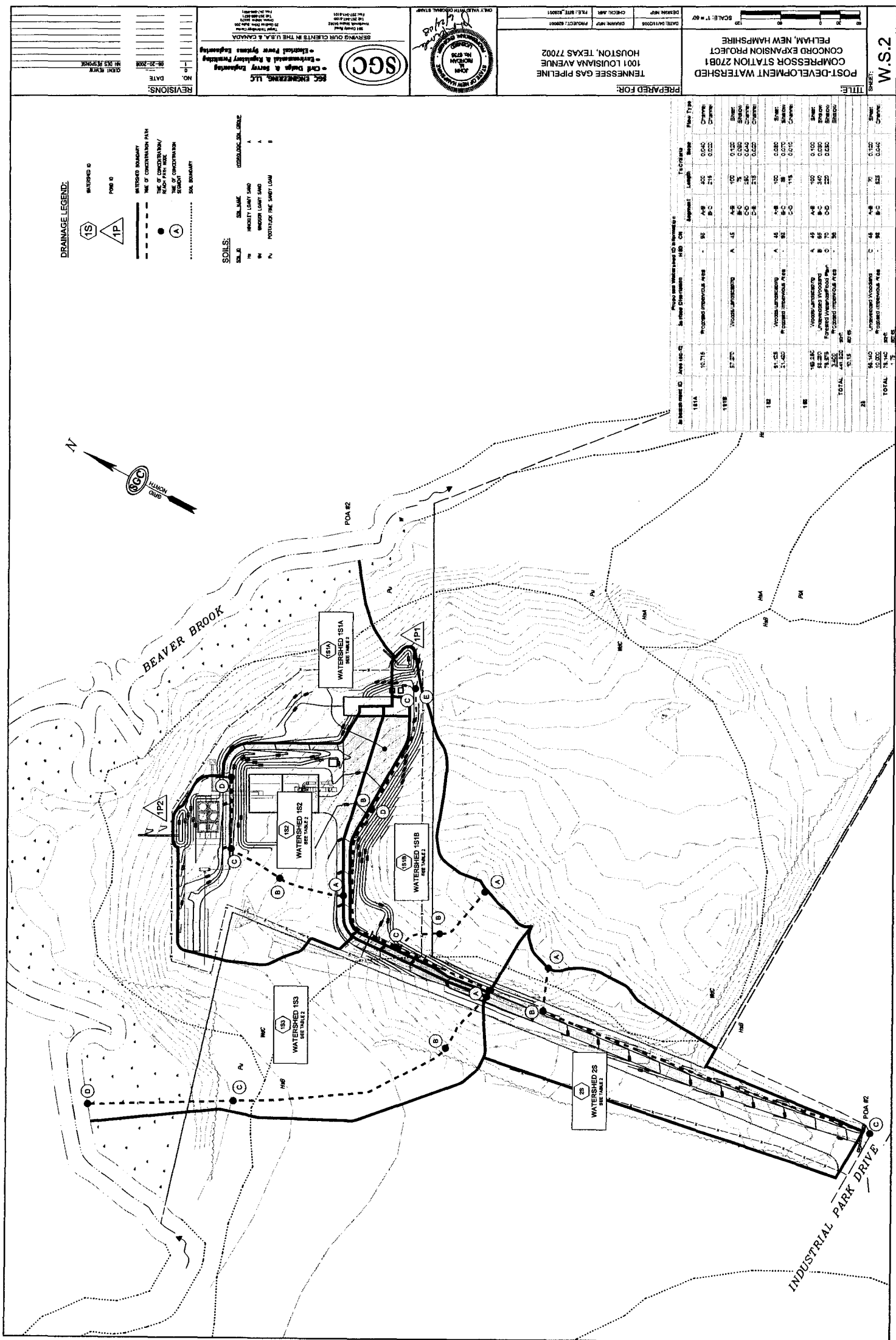
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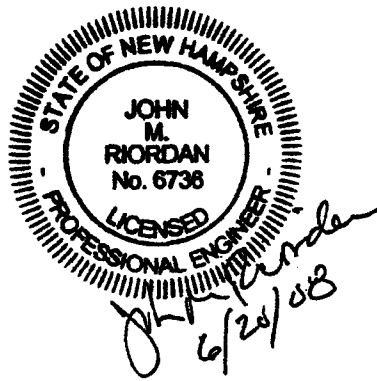
STORMWATER MANAGEMENT REPORT

TENNESSEE GAS PIPELINE

COMPRESSOR STATION 270B1

PELHAM, NEW HAMPSHIRE

June 2008



Prepared for:
Tennessee Gas Pipeline, an El Paso Company
1001 Louisiana Avenue
Houston, Texas

Prepared By:
SGC Engineering, LLC
Westbrook, Maine

Project No. 628001



Table of Contents

Technical Submissions

- Stormwater Management Summary
- Pre-Development Drainage Calculations
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 - 2-Year Runoff Calculations
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 - 50-Year Runoff Calculations
- Sizing Calculations
 - 10'-Wide Stone Overflow

Appendix

- Beaver Brook Watershed Exhibit

Project Plans

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Sheet 2.0	Entrance Road Plan and Profile
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W.S. 1	Pre-Development Watershed Plan
W.S. 2	Post-Development Watershed Plan

Stormwater Management Summary
Tennessee Gas Pipeline – Compressor Station 270B1
Industrial Park Drive – Pelham, New Hampshire

Project Description

Tennessee Gas Pipeline (an El Paso Company) is proposing a new liquid natural gas compressor station in Pelham, New Hampshire that will be accessed from Industrial Park Drive. This compressor station will be located immediately adjacent to a 50-foot wide easement containing two existing natural gas pipelines. These pipelines run in a north-south orientation through Pelham and its industrial park. The subject parcel is identified as Lot 5-111 on the Town of Pelham Assessor's Map 1. The 10.4-acre property is undeveloped and forested with access provided by an existing gravel drive from Industrial Park Drive that parallels the existing gas pipeline. A water main also occupies an easement adjacent to the pipeline. Beaver Brook forms the northerly property boundary and is also the townline between Pelham and Windham, New Hampshire. The parcel generally slopes to the north Beaver Brook and its bordering wetlands at an average of 8-12%.

The project's primary physical components are a control building, the compressor building, and the blower facilities. The existing gravel access will be upgraded to a paved access road and additional pavement will be provided for parking. In total, the project consists of approximately 45,600 sq-ft of new impervious coverage. Approximately 34,000 sq-ft is attributed to roads and parking with the remaining impervious surface associated with the actual compressor station facilities. Municipal water is to be provided from the water main that runs through the property. A small subsurface wastewater disposal system has been designed and included in the project plans.

Soil Conditions

We have used Hillsborough County USDA Soil Conservation Service mapping as the basis for the hydrologic group classification of the on-site soils. The upland portion of the site is predominated by Hinckley and Windsor Loamy Sands (HSG A). A strip of Pootatuck Fine Sandy Loam (HSG B) is adjacent to Beaver Brook and its bordering wetlands. Numerous test pits have been conducted on site as part of the geotechnical evaluation and septic design for the project and have confirmed the sandy nature and HSG classification of the soils. Soil limits are provided on the watershed plans W.S.1 and W.S.2.

Stormwater Modeling

SGC Engineering, LLC has utilized HydroCad® Version 8.5 Stormwater Modeling Software for modeling the site in both its pre- and post-development conditions in order to compare the peak rates of runoff for 2-year and 10-year, Type III 24-hour storm events. 50-year runoff calculations are provided for the post-development condition to illustrate the suitability of the proposed pond



outlets to adequately convey stormwater without overtopping. The peak rates are summarized below in Table 1. HydroCad output for each storm event is attached to document the modeling methodology.

Existing Drainage Conditions

The parcel has two distinct drainage sheds shown on the attached sheet W.S.1. The northerly portion of the site drains from the natural high point toward Beaver Brook. This watershed is modeled as Watershed 1S and is comprised of approximately 10.4 acres of undeveloped land. Watershed 1S comprises the entire project site with the exception of a portion of the entrance road. Runoff from this watershed is modeled in the attached Hydrocad output as discharging to Point of Analysis (POA) #1. The entrance road drains in the southerly direction away from the high point back toward Industrial Park Drive. This watershed is modeled as Watershed 2S and is approximately 1.75 acres in size. Runoff from the site to Industrial Park Drive is modeled as discharging to POA #2. The calculated runoff rates for the undeveloped parcel are very low as should be expected based on the well-drained on-site soils. Beaver Brook is approximately 30-40 feet wide and 3-4 feet deep as it meanders from west to east in the vicinity of the project site. The overall Beaver Brook watershed is approximately 47,000 acres and the watershed tributary to Beaver Brook at the project site is approximately 30,000 acres. A watershed map illustrating the Beaver Brook watershed is included as Appendix A. Based on a review of the runoff analysis for the parcel in its undeveloped state suggests that runoff from the property has very little influence on the flow characteristics of Beaver Brook.

The predicted runoff rates for both of the drainage areas are summarized below in Table 1.

Proposed Drainage Conditions

As noted above, the project will create approximately 45,600 sq-ft of new impervious coverage associated with access road construction and site development. Inherently, this will create an increase in stormwater runoff off site if some form of stormwater infiltration/detention is not provided. Stormwater detention is provided utilizing two small, 4'-deep (3' effective depth) stormwater impoundments. It is also assumed, though not accounted for in the model, that a significant amount of exfiltration will occur from the newly constructed swales and stormwater impoundments.

We have used the same two Points of Analysis in the models for the proposed stormwater conditions as well as for the existing conditions to illustrate that runoff rates generated by the property after the development is completed will be in acceptable ranges when compared to existing runoff rates. A comparison of pre-development vs. post-development flows is summarized in Table 1 below.

Point of Analysis #1 (Beaver Brook) remains the major discharge location for the property. For the post-development model Watershed 1S1 has been 'sub-divided' into four smaller watersheds (1S1A, 1S1B, 1S2, and 1S3) to more accurately model the runoff conditions of the proposed site



development. Watershed 1S1A and 1S1B comprise the most southerly portion of the developed area. These watersheds drain to the stormwater impoundment modeled as Pond 1P1 which is located adjacent to the proposed control building. Watershed 1S1A contains the impervious component of the land cover tributary to Pond 1P1, Watershed 1S1B contains the undeveloped/landscaped component which drains to Pond 1P1. The combined runoff from these two watersheds is less than 1 cfs during the 10-year event and is reduced to 0.27 cfs once modeled in conjunction with 1P1. Pond 1P1 has a three-foot effective depth and outlet flow rates will be mitigated by an orifice controlled outlet structure. This structure is detailed on Sheet 3.2. A 10'-wide stone overflow has been provided to function as a secondary outlet and emergency spillway during more significant rainfall events. During the 50-year event, 0.88 feet of freeboard is available from the peak water elevation to the top of the pond berm. A plunge pool/level spreader is provided at the pond outlet to return the runoff to sheet flow. The area down-gradient of the plunge pool/level spreader will be maintained as a forested buffer to provide stormwater treatment prior to the runoff entering Beaver Brook.

Watershed 1S2 represents the majority of the developed portion of the facility. This watershed will be drained via the use of several grassed drainage swales with stone check dams. Ultimately the watershed drains to a stormwater impoundment modeled as Pond 1P2 situated behind the blower assembly. The impoundment will have a three-foot effective depth similar to Pond 1P1 and outflow rates will be mitigated by implementing a similar orifice controlled outlet structure. Pond 1P2 also utilizes a 10'-wide stone overflow for larger storm events. During the 50-year event, 0.83 feet of freeboard is available from the peak water elevation to the top of the pond berm. The collected runoff from each of these outlets is routed to a plunge pool/level spreader to return the runoff to sheet flow prior to discharge to a maintained forested buffer.

Post-development Watershed 1S3 represents the remaining undeveloped portion of the site that is tributary to Beaver Brook/POA #1. Runoff in this watershed will not be altered by the proposed site plan.

Watershed 2S will remain tributary to Industrial Park Drive/POA#2. This watershed is essentially unaltered from its existing condition. The proposed plan includes upgrading the entrance road from gravel to pavement and sloping the paved surface to the swale on the east side of the road. The swale will be sloped and vegetated to provide effective erosion control and stormwater treatment.

We have evaluated runoff at the same points of analysis used to model existing runoff. Stormwater is proposed to be managed so that post-development runoff rates will not be substantially different from those experienced under pre-development conditions. The following summary of runoff rates demonstrate that the proposed stormwater management practices will be successful in mitigating the effects of the impervious surfaces proposed to be constructed within this development:



Table 1 - Stormwater Discharge Summary

Location	Event	Runoff Rate, cfs	
		Existing	Proposed
POA #1: Beaver Brook	2-Year	2.9	0.23
	10-Year	4.3	2.99
POA #2: Industrial Park Drive	2-Year	2.9	0.09
	10-Year	4.3	0.72
<u>Net Off-Property Runoff</u>	2-Year	<u>0.32</u>	<u>0.75</u>
	10-Year	<u>3.71</u>	<u>3.72</u>

As reported, the runoff from the site to Beaver Brook will experience a slight increase as modeled. Given that Beaver Brook is approximately 30-40'-wide and 3-4'-deep in the vicinity of the project site and has an overall tributary area of approximately 30,000 acres, the minor projected increases will not alter the capacity of the brook or adversely affect down-gradient drainage facilities.

Stormwater Quality

Vegetated filter strips/buffers will be preserved to provide adequate stormwater treatment consistent with the requirements of the New Hampshire DES Site Specific Application. Each of the two stormwater impoundments will outlet to a preserved forested buffer outside of the compressor station fence line that will function as a natural filter of stormwater prior to its discharge to Beaver Brook. The projected flow rates for the 10-year storm entering into the buffers from Ponds 1P1 and 1P2 have a maximum value of 0.27 cfs. The well-drained soils and micro-topography within the buffer areas will further attenuate flow rates and encourage sediment removal prior to discharging into Beaver Brook.

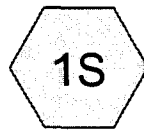
To treat the stormwater runoff from Watershed 2S, stone check dams have been added to the roadside swale to encourage filtering and infiltration of runoff discharged from the road surface. The roadway has been designed with a cross slope to the right (east) from Station 0+00 to 6+12.5. This will consolidate all of the roadway runoff in Watershed 2S in the roadside swale on the right side of the proposed road. In addition to the improved treatment provided by upgrading the gravel road to pavement and providing a grassed roadway swale, the roadside swale from Station 0+00 to Station 1+50 has been flattened to 2% (roadway grade is 4%). By flattening the swales, the velocity and flow rate within the swale is below 1 fps and 10 cfs respectively. This meets criteria for treatment swales outlined in Ws 415.12. The runoff in the roadside swale from Station 0+00 to 1+50 is modeled as Reach 2R to illustrate the adequacy of treatment.



PRE-DEVELOPMENT DRAINAGE CALCULATIONS



Beaver Brook



Watershed 1S



Watershed 2S



Industrial Park Road



Drainage Diagram for Pre-Development
Prepared by SGC Engineering, LLC

HydroCAD® 8.50 s/n 002423 © 2007 HydroCAD Software Solutions LLC

TABLE 1
Existing Watershed ID Information

Subcatchment ID	Area (sq-ft)	Surface Discription	HSG	CN	Tc Criteria			Flow Type
					Segment	Length	Slope	
1S	309,415	Woods/Grass	A	45	A-B	100	0.080	Sheet
	58,280	Woods/Grass	B	65	B-C	300	0.120	Shallow
	76,575	Forested Wetlands/Flood Plain	C	70	C-D	45	0.180	Shallow
	<u>8,365</u>	Existing Gravel Access	-	98	D-E	150	0.130	Shallow
	TOTAL	452,635 sq-ft 10.39 acres						
2S	61,360	Undeveloped Woodland	C	45	A-B	70	0.120	Sheet
	<u>14,780</u>	Existing Gravel Access	-	98	B-C	500	0.040	Channel
	TOTAL	76,140 sq-ft 1.75 acres						

2-YEAR RUNOFF CALCULATIONS

Pre-Development*Type III 24-hr 2-Year Rainfall=2.90"*

Prepared by SGC Engineering, LLC

HydroCAD® 8.50 s/n 002423 © 2007 HydroCAD Software Solutions LLC

Page 1

Time span=1.00-24.00 hrs, dt=0.05 hrs, 461 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Watershed 1SRunoff Area=452,635 sf 1.85% Impervious Runoff Depth>0.13"
Flow Length=595' Tc=17.7 min CN=53 Runoff=0.23 cfs 0.109 af**Subcatchment 2S: Watershed 2S**Runoff Area=76,140 sf 19.41% Impervious Runoff Depth>0.17"
Flow Length=570' Tc=12.4 min CN=55 Runoff=0.09 cfs 0.024 af**Link POA 1: Beaver Brook**Inflow=0.23 cfs 0.109 af
Primary=0.23 cfs 0.109 af**Link POA 2: Industrial Park Road**Inflow=0.09 cfs 0.024 af
Primary=0.09 cfs 0.024 af**Total Runoff Area = 12.139 ac Runoff Volume = 0.133 af Average Runoff Depth = 0.13"**
95.62% Pervious = 11.608 ac 4.38% Impervious = 0.531 ac

Pre-Development

Type III 24-hr 2-Year Rainfall=2.90"

Prepared by SGC Engineering, LLC

HydroCAD® 8.50 s/n 002423 © 2007 HydroCAD Software Solutions LLC

Page 2

Summary for Subcatchment 1S: Watershed 1S

Runoff = 0.23 cfs @ 12.65 hrs, Volume= 0.109 af, Depth> 0.13"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=2.90"

	Area (sf)	CN	Description
*	309,415	45	Woods/Grass HSG A
*	58,280	65	Woods/Grass HSG B
*	76,575	70	Forested Wetlands/Flood Plain
*	8,365	98	Existing Gravel Access
	452,635	53	Weighted Average
	444,270		Pervious Area
	8,365		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.0	100	0.0800	0.13		Sheet Flow, Sheet Flow Segment A-B Woods: Light underbrush n= 0.400 P2= 2.90"
2.9	300	0.1200	1.73		Shallow Concentrated Flow, Shallow Flow, Segment B-C Woodland Kv= 5.0 fps
0.4	45	0.1800	2.12		Shallow Concentrated Flow, Shallow Flow, Segment C-D Woodland Kv= 5.0 fps
1.4	150	0.1300	1.80		Shallow Concentrated Flow, Shallow Flow, Segment D-E Woodland Kv= 5.0 fps
17.7	595	Total			

Pre-Development

Type III 24-hr 2-Year Rainfall=2.90"

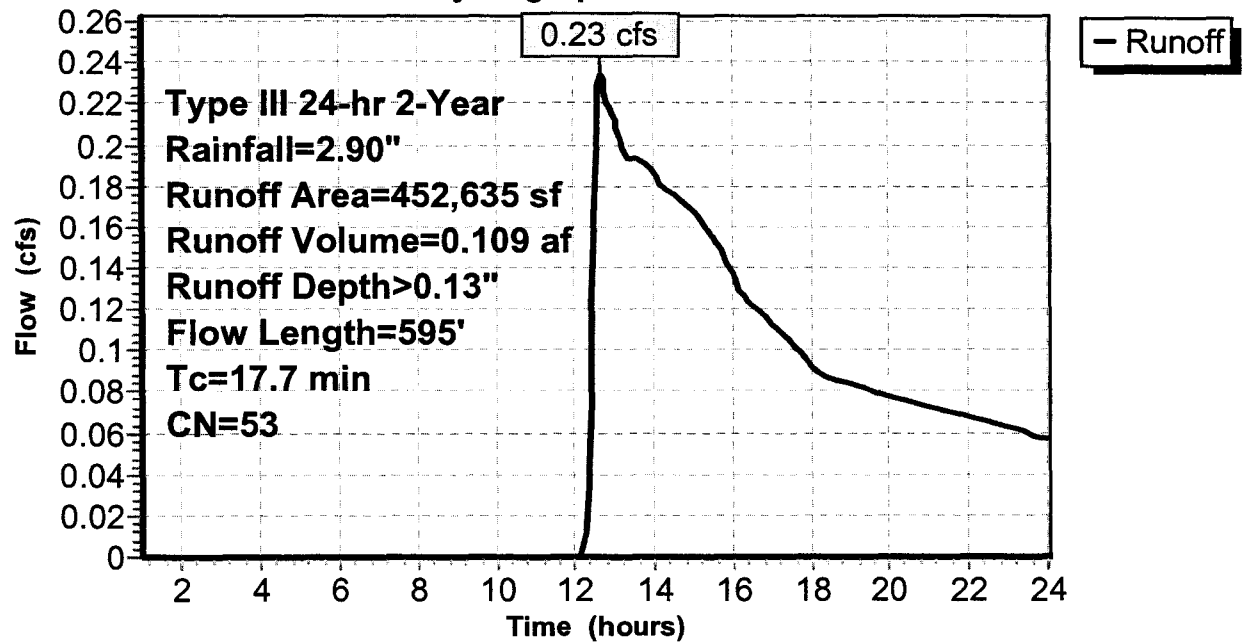
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Subcatchment 1S: Watershed 1S

Hydrograph



Pre-Development

Type III 24-hr 2-Year Rainfall=2.90"

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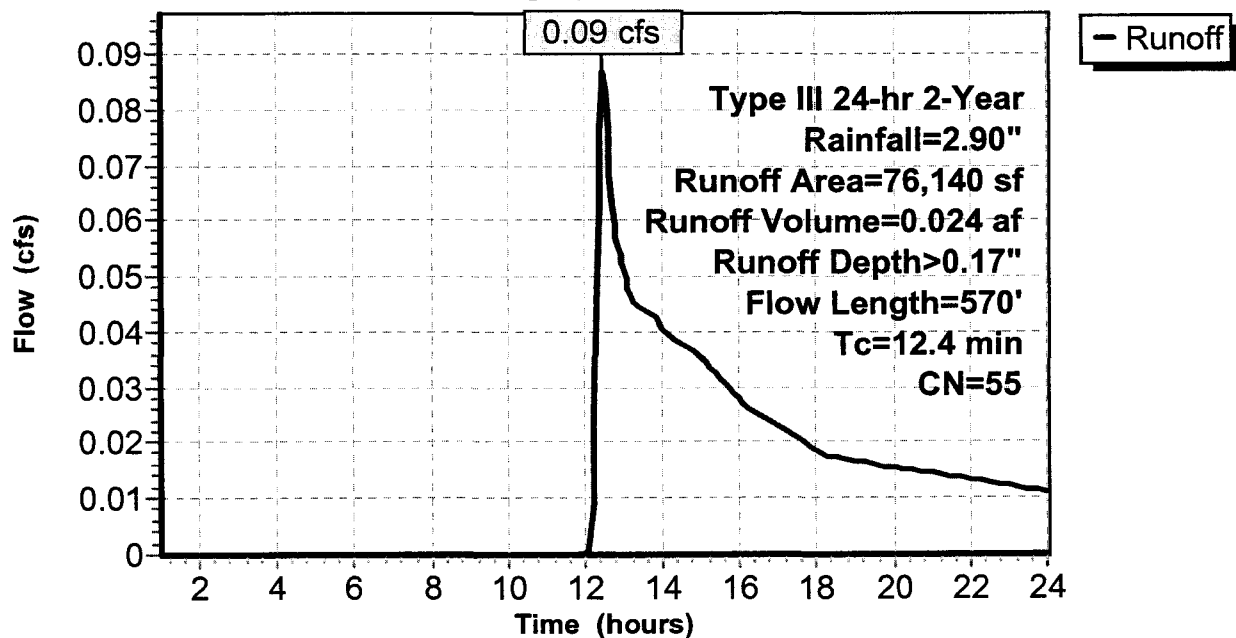
Summary for Subcatchment 2S: Watershed 2S

Runoff = 0.09 cfs @ 12.49 hrs, Volume= 0.024 af, Depth> 0.17"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=2.90"

	Area (sf)	CN	Description
*	61,360	45	Woods/Grass HSG A
*	14,780	98	Existing Gravel Access
	76,140	55	Weighted Average
	61,360		Pervious Area
	14,780		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.7	70	0.0800	0.12		Sheet Flow, Sheet Flow Segment A-B
2.7	500	0.0400	3.03	0.76	Woods: Light underbrush n= 0.400 P2= 2.90"
					Trap/Vee/Rect Channel Flow, Roadside Ditch
					Bot.W=0.00' D=0.25' Z= 4.0' / Top.W=2.00' n= 0.024
12.4	570	Total			

Subcatchment 2S: Watershed 2S**Hydrograph**

Pre-Development

Type III 24-hr 2-Year Rainfall=2.90"

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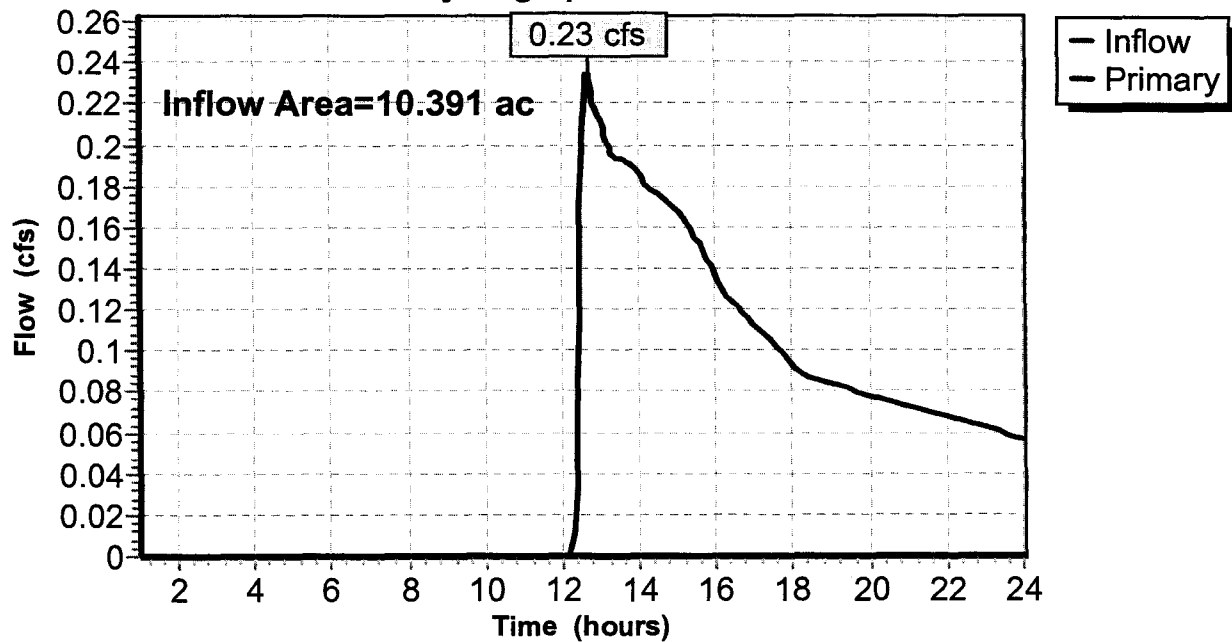
Summary for Link POA 1: Beaver Brook

Inflow Area = 10.391 ac, 1.85% Impervious, Inflow Depth > 0.13" for 2-Year event
Inflow = 0.23 cfs @ 12.65 hrs, Volume= 0.109 af
Primary = 0.23 cfs @ 12.65 hrs, Volume= 0.109 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs

Link POA 1: Beaver Brook

Hydrograph



Pre-Development

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Type III 24-hr 2-Year Rainfall=2.90"

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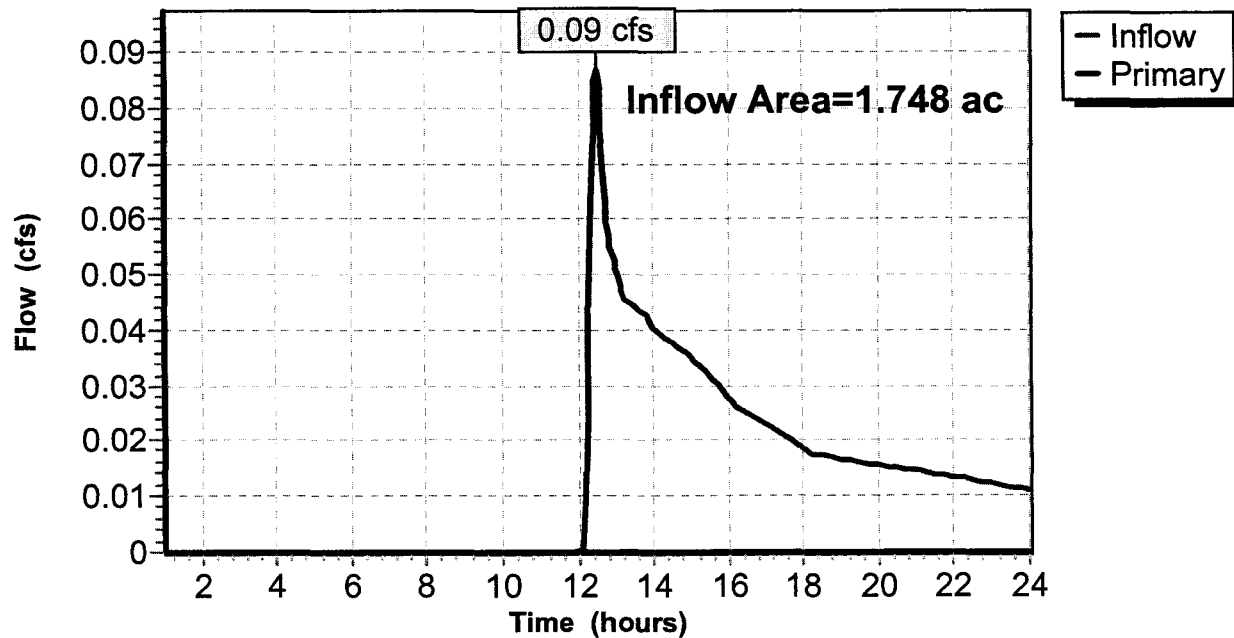
Summary for Link POA 2: Industrial Park Road

Inflow Area = 1.748 ac, 19.41% Impervious, Inflow Depth > 0.17" for 2-Year event
Inflow = 0.09 cfs @ 12.49 hrs, Volume= 0.024 af
Primary = 0.09 cfs @ 12.49 hrs, Volume= 0.024 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs

Link POA 2: Industrial Park Road

Hydrograph



10-YEAR RUNOFF CALCULATIONS

Pre-Development*Type III 24-hr 10-Year Rainfall=4.30"*

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Time span=1.00-24.00 hrs, dt=0.05 hrs, 461 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Watershed 1SRunoff Area=452,635 sf 1.85% Impervious Runoff Depth>0.56"
Flow Length=595' Tc=17.7 min CN=53 Runoff=2.99 cfs 0.482 af**Subcatchment 2S: Watershed 2S**Runoff Area=76,140 sf 19.41% Impervious Runoff Depth>0.65"
Flow Length=570' Tc=12.4 min CN=55 Runoff=0.72 cfs 0.095 af**Link POA 1: Beaver Brook**Inflow=2.99 cfs 0.482 af
Primary=2.99 cfs 0.482 af**Link POA 2: Industrial Park Road**Inflow=0.72 cfs 0.095 af
Primary=0.72 cfs 0.095 af**Total Runoff Area = 12.139 ac Runoff Volume = 0.577 af Average Runoff Depth = 0.57"**
95.62% Pervious = 11.608 ac 4.38% Impervious = 0.531 ac

Pre-Development

Type III 24-hr 10-Year Rainfall=4.30"

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Summary for Subcatchment 1S: Watershed 1S

Runoff = 2.99 cfs @ 12.37 hrs, Volume= 0.482 af, Depth> 0.56"

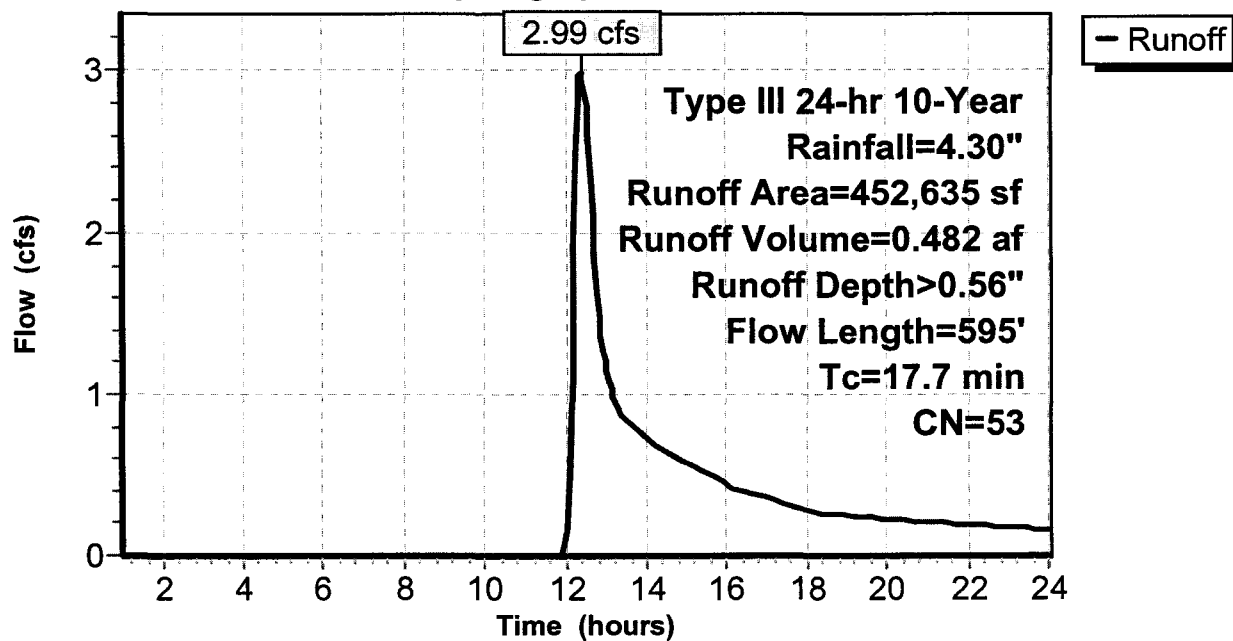
Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.30"

	Area (sf)	CN	Description
*	309,415	45	Woods/Grass HSG A
*	58,280	65	Woods/Grass HSG B
*	76,575	70	Forested Wetlands/Flood Plain
*	8,365	98	Existing Gravel Access
	452,635	53	Weighted Average
	444,270		Pervious Area
	8,365		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.0	100	0.0800	0.13		Sheet Flow, Sheet Flow Segment A-B
					Woods: Light underbrush n= 0.400 P2= 2.90"
2.9	300	0.1200	1.73		Shallow Concentrated Flow, Shallow Flow, Segment B-C
					Woodland Kv= 5.0 fps
0.4	45	0.1800	2.12		Shallow Concentrated Flow, Shallow Flow, Segment C-D
					Woodland Kv= 5.0 fps
1.4	150	0.1300	1.80		Shallow Concentrated Flow, Shallow Flow, Segment D-E
					Woodland Kv= 5.0 fps
17.7	595	Total			

Subcatchment 1S: Watershed 1S

Hydrograph



Pre-Development

Type III 24-hr 10-Year Rainfall=4.30"

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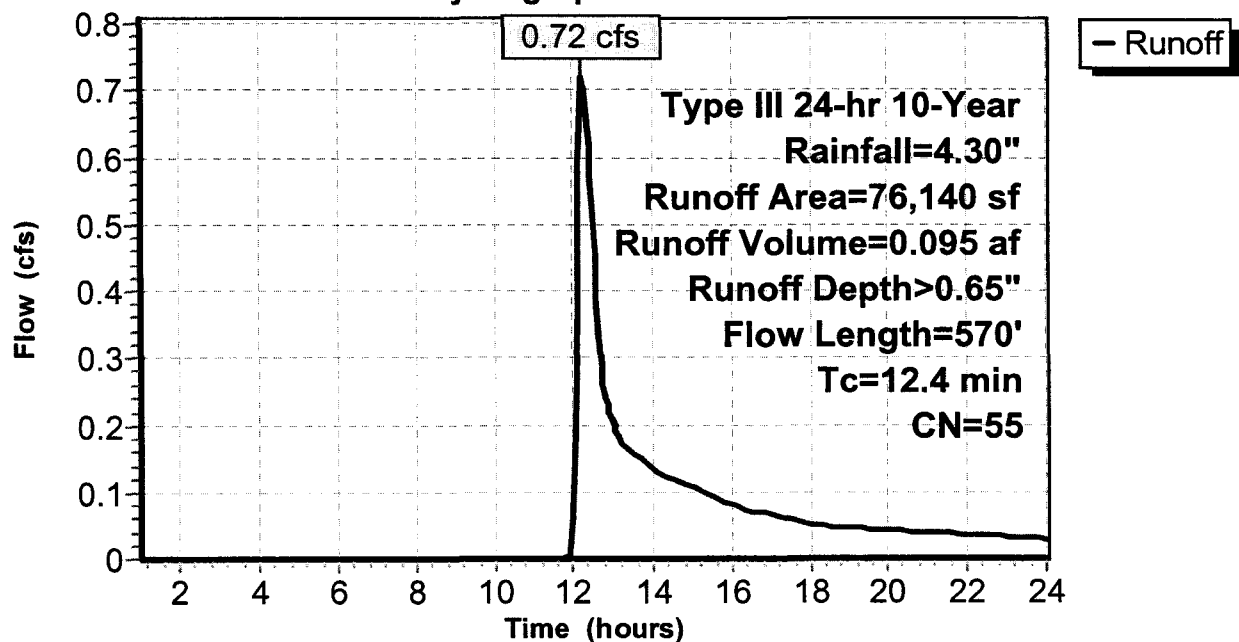
Summary for Subcatchment 2S: Watershed 2S

Runoff = 0.72 cfs @ 12.23 hrs, Volume= 0.095 af, Depth> 0.65"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.30"

	Area (sf)	CN	Description
*	61,360	45	Woods/Grass HSG A
*	14,780	98	Existing Gravel Access
	76,140	55	Weighted Average
	61,360		Pervious Area
	14,780		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.7	70	0.0800	0.12		Sheet Flow, Sheet Flow Segment A-B
					Woods: Light underbrush n= 0.400 P2= 2.90"
2.7	500	0.0400	3.03	0.76	Trap/Vee/Rect Channel Flow, Roadside Ditch
					Bot.W=0.00' D=0.25' Z= 4.0 ' Top.W=2.00' n= 0.024
12.4	570	Total			

Subcatchment 2S: Watershed 2S**Hydrograph**

Pre-Development

Type III 24-hr 10-Year Rainfall=4.30"

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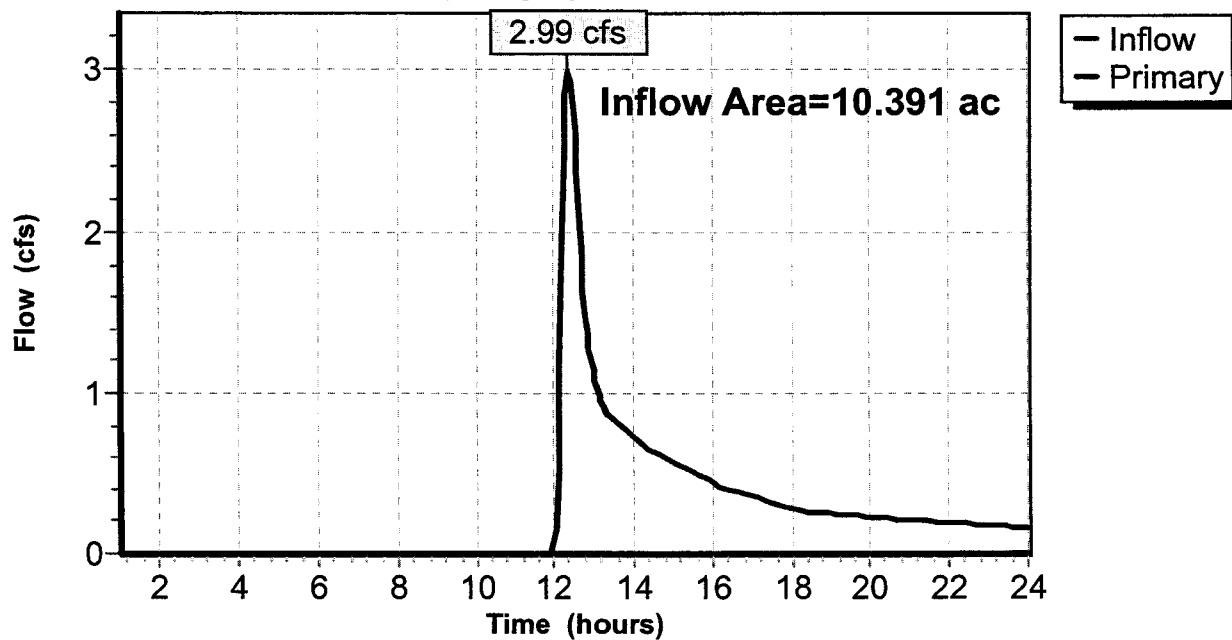
Summary for Link POA 1: Beaver Brook

Inflow Area = 10.391 ac, 1.85% Impervious, Inflow Depth > 0.56" for 10-Year event
Inflow = 2.99 cfs @ 12.37 hrs, Volume= 0.482 af
Primary = 2.99 cfs @ 12.37 hrs, Volume= 0.482 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs

Link POA 1: Beaver Brook

Hydrograph



Pre-Development

Type III 24-hr 10-Year Rainfall=4.30"

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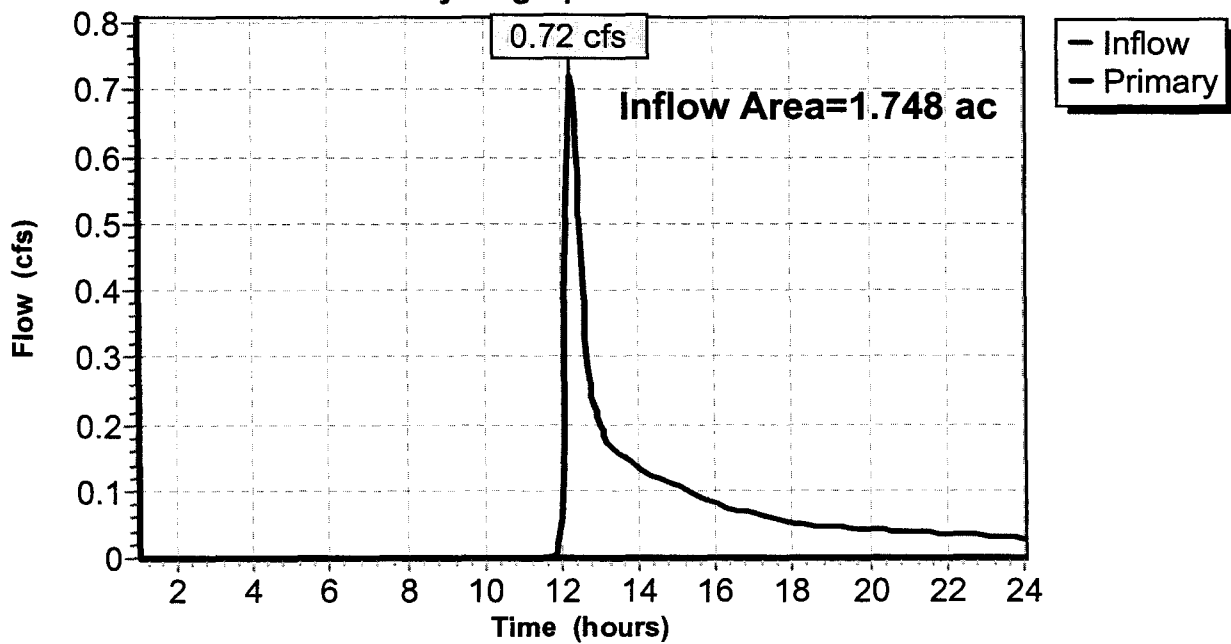
Summary for Link POA 2: Industrial Park Road

Inflow Area = 1.748 ac, 19.41% Impervious, Inflow Depth > 0.65" for 10-Year event
Inflow = 0.72 cfs @ 12.23 hrs, Volume= 0.095 af
Primary = 0.72 cfs @ 12.23 hrs, Volume= 0.095 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs

Link POA 2: Industrial Park Road

Hydrograph



POST-DEVELOPMENT DRAINAGE CALCULATIONS

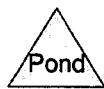
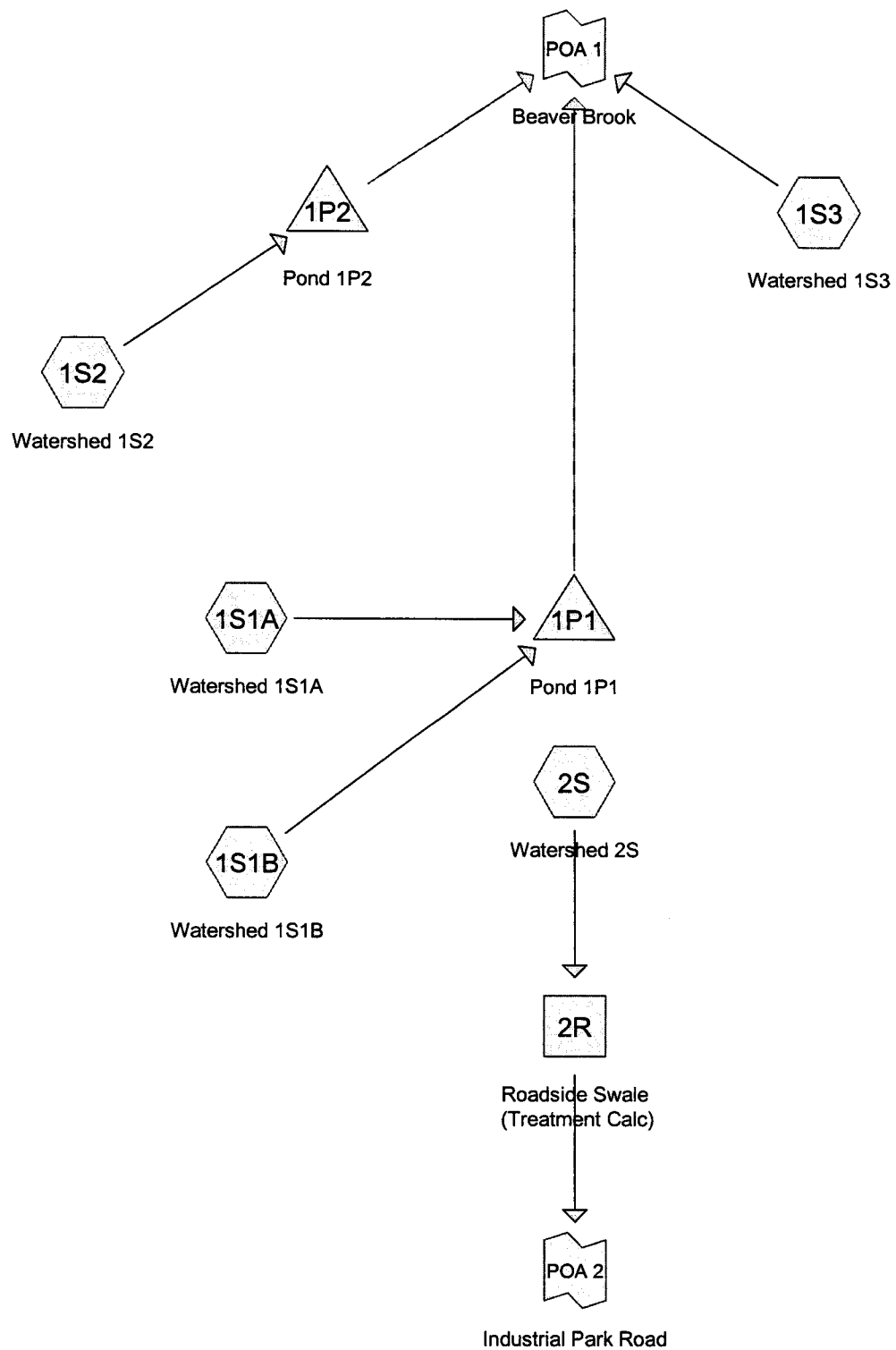


TABLE 2
Proposed Watershed ID Information

Subcatchment ID	Area (sq-ft)	Surface Discription	HSG	CN	Segment	Tc Criteria Length	Slope	Flow Type
1S1A	10,715	Proposed Impervious Area	-	98	A-B	400	0.040	Channel
					B-C	215	0.020	Channel
1S1B	57,870	Woods/Landscaping	A	45	A-B	100	0.120	Sheet
					B-C	75	0.080	Shallow
					C-D	250	0.040	Channel
					D-E	215	0.020	Channel
1S2	61,125	Woods/Landscaping	A	45	A-B	100	0.080	Sheet
	21,420	Proposed Impervious Area	-	98	B-C	85	0.070	Shallow
					C-D	115	0.010	Channel
1S3	163,250	Woods/Landscaping	A	45	A-B	100	0.100	Sheet
	58,280	Undeveloped Woodland	B	65	B-C	340	0.080	Shallow
	76,575	Forested Wetlands/Flood Plain	C	70	C-D	220	0.050	Shallow
	<u>3,400</u>	Proposed Impervious Area	-	98				Shallow
TOTAL	441,920	sq-ft						
	10.15	acres						
2S	66,140	Undeveloped Woodland	C	45	A-B	70	0.120	Sheet
	<u>10,000</u>	Proposed Impervious Area	-	98	B-C	525	0.040	Channel
TOTAL	76,140	sq-ft						
	1.75	acres						

2-YEAR RUNOFF CALCULATIONS

Post-Development

Type III 24-hr 2-Year Rainfall=2.90"

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Page 1

Time span=1.00-24.00 hrs, dt=0.05 hrs, 461 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S1A: Watershed 1S1A Runoff Area=10,715 sf 100.00% Impervious Runoff Depth>2.66"
Flow Length=615' Tc=13.0 min CN=98 Runoff=0.55 cfs 0.055 af

Subcatchment1S1B: Watershed 1S1B Runoff Area=57,870 sf 0.00% Impervious Runoff Depth>0.02"
Flow Length=640' Tc=22.1 min CN=45 Runoff=0.00 cfs 0.002 af

Subcatchment1S2: Watershed 1S2 Runoff Area=82,545 sf 25.95% Impervious Runoff Depth>0.27"
Flow Length=300' Tc=18.4 min CN=59 Runoff=0.21 cfs 0.042 af

Subcatchment1S3: Watershed 1S3 Runoff Area=301,505 sf 1.13% Impervious Runoff Depth>0.19"
Flow Length=660' Tc=19.1 min CN=56 Runoff=0.40 cfs 0.110 af

Subcatchment2S: Watershed 2S Runoff Area=76,140 sf 13.13% Impervious Runoff Depth>0.11"
Flow Length=595' Tc=19.5 min CN=52 Runoff=0.03 cfs 0.016 af

Reach 2R: Roadside Swale (Treatment Calc) Avg. Depth=0.05' Max Vel=0.27 fps Inflow=0.03 cfs 0.016 af
n=0.100 L=150.0' S=0.0200 '/' Capacity=35.66 cfs Outflow=0.03 cfs 0.015 af

Pond 1P1: Pond 1P1 Peak Elev=177.99' Storage=537 cf Inflow=0.55 cfs 0.056 af
Primary=0.23 cfs 0.056 af Secondary=0.00 cfs 0.000 af Outflow=0.23 cfs 0.056 af

Pond 1P2: Pond 1P2 Peak Elev=170.55' Storage=226 cf Inflow=0.21 cfs 0.042 af
Primary=0.11 cfs 0.041 af Secondary=0.00 cfs 0.000 af Outflow=0.11 cfs 0.041 af

Link POA 1: Beaver Brook Inflow=0.72 cfs 0.207 af
Primary=0.72 cfs 0.207 af

Link POA 2: Industrial Park Road Inflow=0.03 cfs 0.015 af
Primary=0.03 cfs 0.015 af

Total Runoff Area = 12.139 ac Runoff Volume = 0.224 af Average Runoff Depth = 0.22"
91.39% Pervious = 11.094 ac 8.61% Impervious = 1.045 ac

Post-Development

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Type III 24-hr 2-Year Rainfall=2.90"

Page 2

Summary for Subcatchment 1S1A: Watershed 1S1A

Runoff = 0.55 cfs @ 12.17 hrs, Volume= 0.055 af, Depth> 2.66"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs

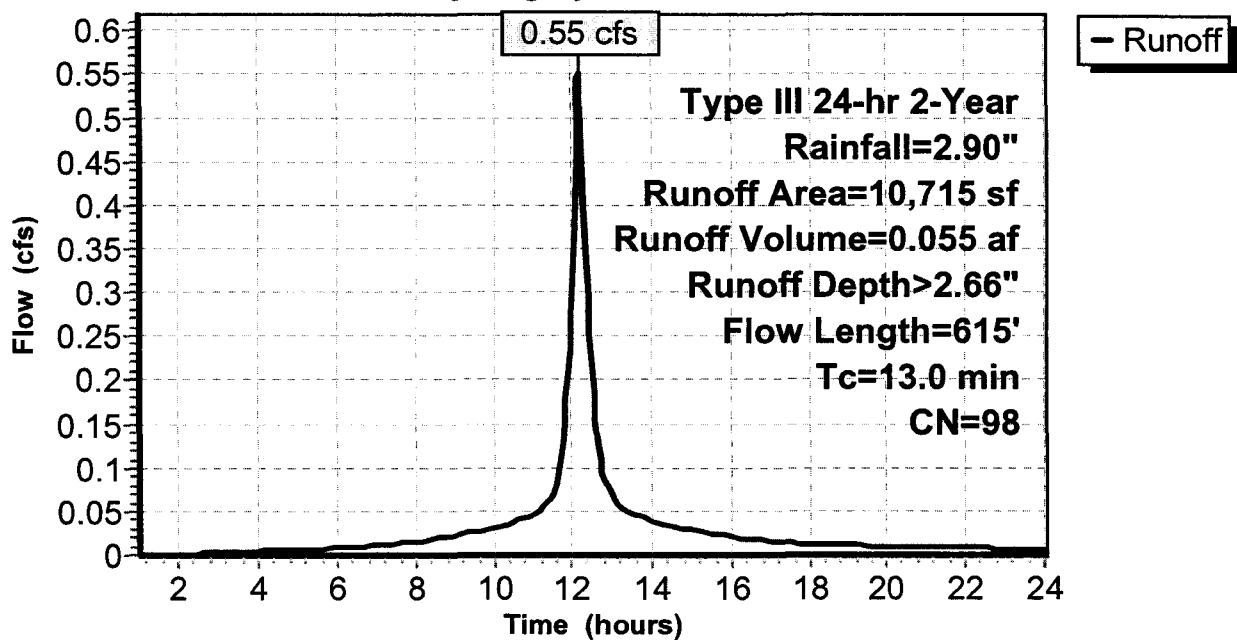
Type III 24-hr 2-Year Rainfall=2.90"

	Area (sf)	CN	Description
*	10,715	98	Proposed Impervious Area
	10,715		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	400	0.0400	0.90	0.43	Trap/Vee/Rect Channel Flow, Roadside Ditch, A-B Bot.W=2.00' D=0.20' Z= 2.0 ' Top.W=2.80' n= 0.100
5.6	215	0.0200	0.63	0.30	Trap/Vee/Rect Channel Flow, Roadside Ditch, D-E Bot.W=2.00' D=0.20' Z= 2.0 ' Top.W=2.80' n= 0.100
13.0	615	Total			

Subcatchment 1S1A: Watershed 1S1A

Hydrograph



Post-Development

Type III 24-hr 2-Year Rainfall=2.90"

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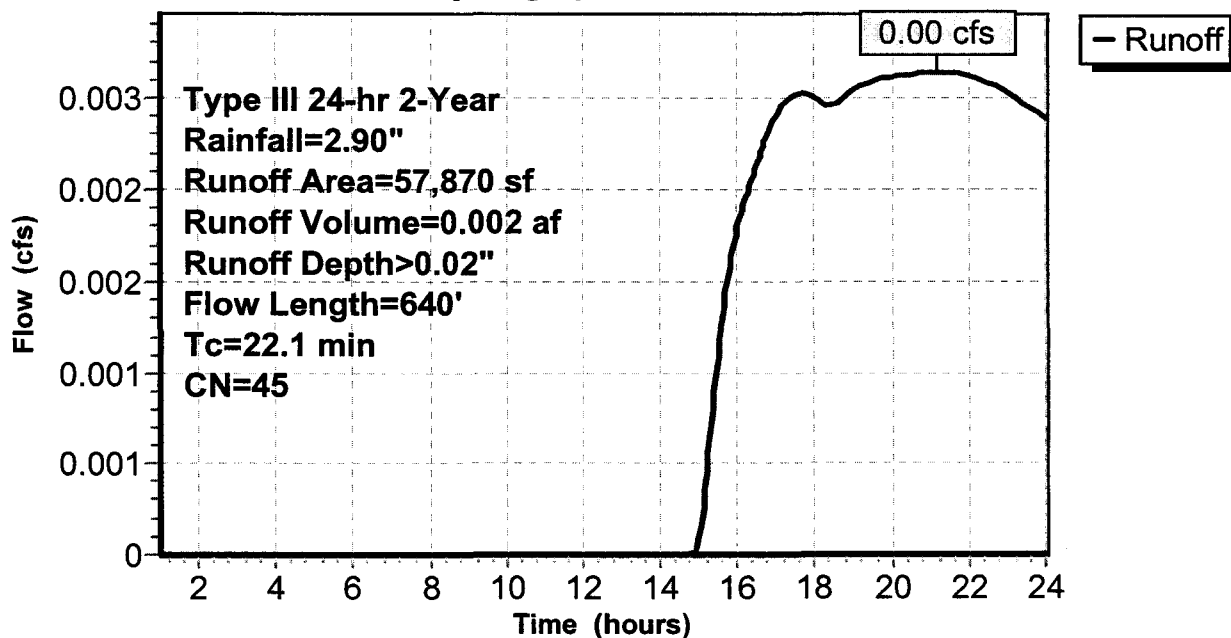
Summary for Subcatchment 1S1B: Watershed 1S1B

Runoff = 0.00 cfs @ 21.16 hrs, Volume= 0.002 af, Depth> 0.02"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=2.90"

	Area (sf)	CN	Description
*	57,870	45	Wood/Landscaping, HSG A
	57,870		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	100	0.1200	0.15		Sheet Flow, Sheet Flow Segment A-B Woods: Light underbrush n= 0.400 P2= 2.90"
0.9	75	0.0800	1.41		Shallow Concentrated Flow, Shallow Flow, Segment B-C Woodland Kv= 5.0 fps
4.6	250	0.0400	0.90	0.43	Trap/Vee/Rect Channel Flow, Roadside Ditch, C-D Bot.W=2.00' D=0.20' Z= 2.0 ' Top.W=2.80' n= 0.100
5.6	215	0.0200	0.63	0.30	Trap/Vee/Rect Channel Flow, Roadside Ditch, D-E Bot.W=2.00' D=0.20' Z= 2.0 ' Top.W=2.80' n= 0.100
22.1	640	Total			

Subcatchment 1S1B: Watershed 1S1B**Hydrograph**

Post-Development

Type III 24-hr 2-Year Rainfall=2.90"

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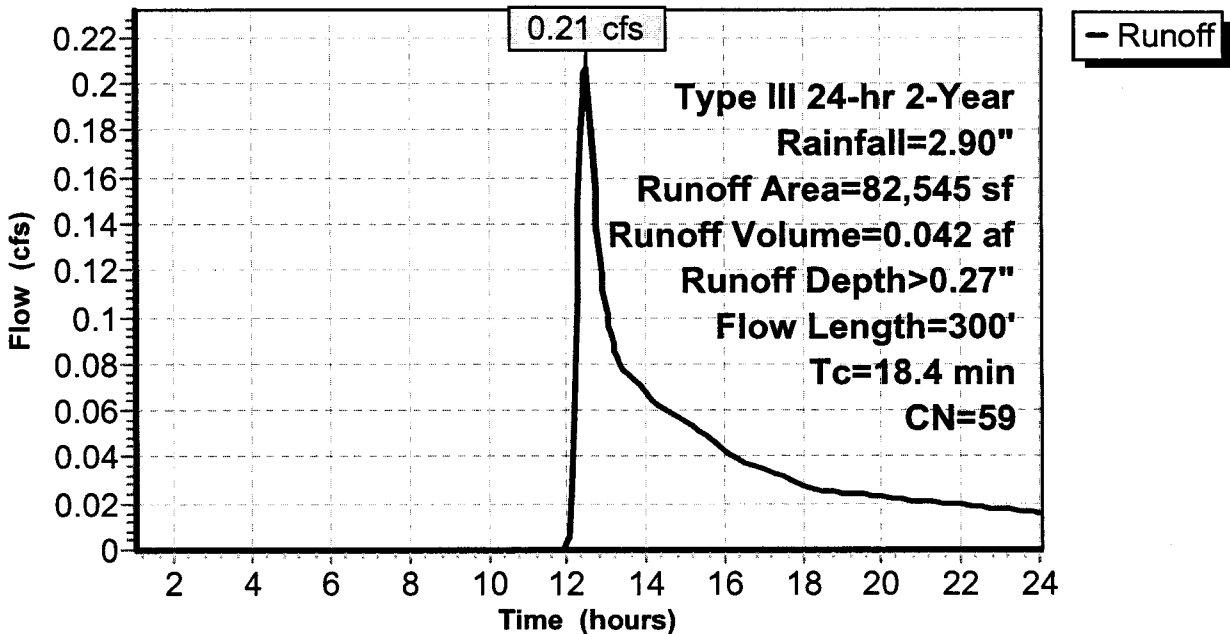
Summary for Subcatchment 1S2: Watershed 1S2

Runoff = 0.21 cfs @ 12.49 hrs, Volume= 0.042 af, Depth> 0.27"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=2.90"

Area (sf)	CN	Description
* 61,125	45	Woods/Landscaping, HSG A
* 21,420	98	Proposed Impervious Area
82,545	59	Weighted Average
61,125		Pervious Area
21,420		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.0	100	0.0800	0.13		Sheet Flow, Sheet Flow Segment A-B Woods: Light underbrush n= 0.400 P2= 2.90"
1.1	85	0.0700	1.32		Shallow Concentrated Flow, Shallow Flow, Segment B-C Woodland Kv= 5.0 fps
4.3	115	0.0100	0.45	0.22	Trap/Vee/Rect Channel Flow, Grassed Swale Bot.W=2.00' D=0.20' Z= 2.0 ' /' Top.W=2.80' n= 0.100
18.4	300	Total			

Subcatchment 1S2: Watershed 1S2**Hydrograph**

Post-Development

Type III 24-hr 2-Year Rainfall=2.90"

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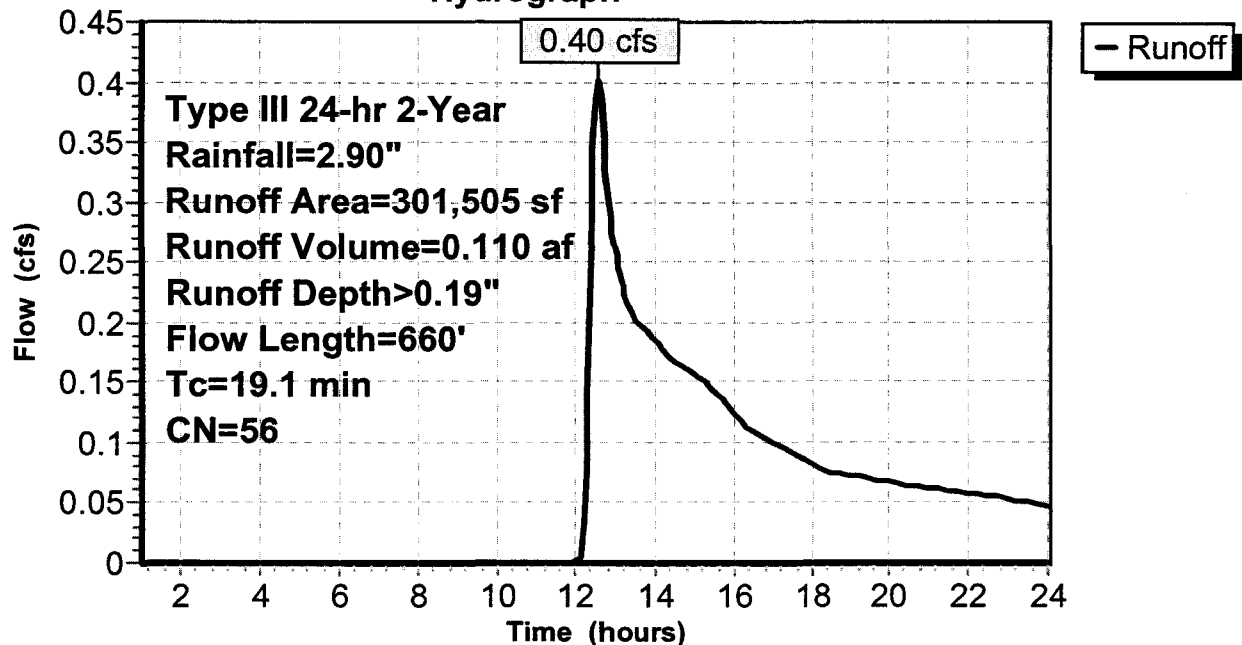
Summary for Subcatchment 1S3: Watershed 1S3

Runoff = 0.40 cfs @ 12.57 hrs, Volume= 0.110 af, Depth> 0.19"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=2.90"

	Area (sf)	CN	Description
*	163,250	45	Woods/Grass HSG A
*	58,280	65	Woods/Grass HSG B
*	76,575	70	Forested Wetlands/Flood Plain
*	3,400	98	Proposed Impervious Area
	301,505	56	Weighted Average
	298,105		Pervious Area
	3,400		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.8	100	0.1000	0.14		Sheet Flow, Sheet Flow Segment A-B Woods: Light underbrush n= 0.400 P2= 2.90"
4.0	340	0.0800	1.41		Shallow Concentrated Flow, Shallow Flow, Segment B-C Woodland Kv= 5.0 fps
3.3	220	0.0500	1.12		Shallow Concentrated Flow, Shallow Flow, Segment C-D Woodland Kv= 5.0 fps
19.1	660	Total			

Subcatchment 1S3: Watershed 1S3**Hydrograph**

Post-Development

Type III 24-hr 2-Year Rainfall=2.90"

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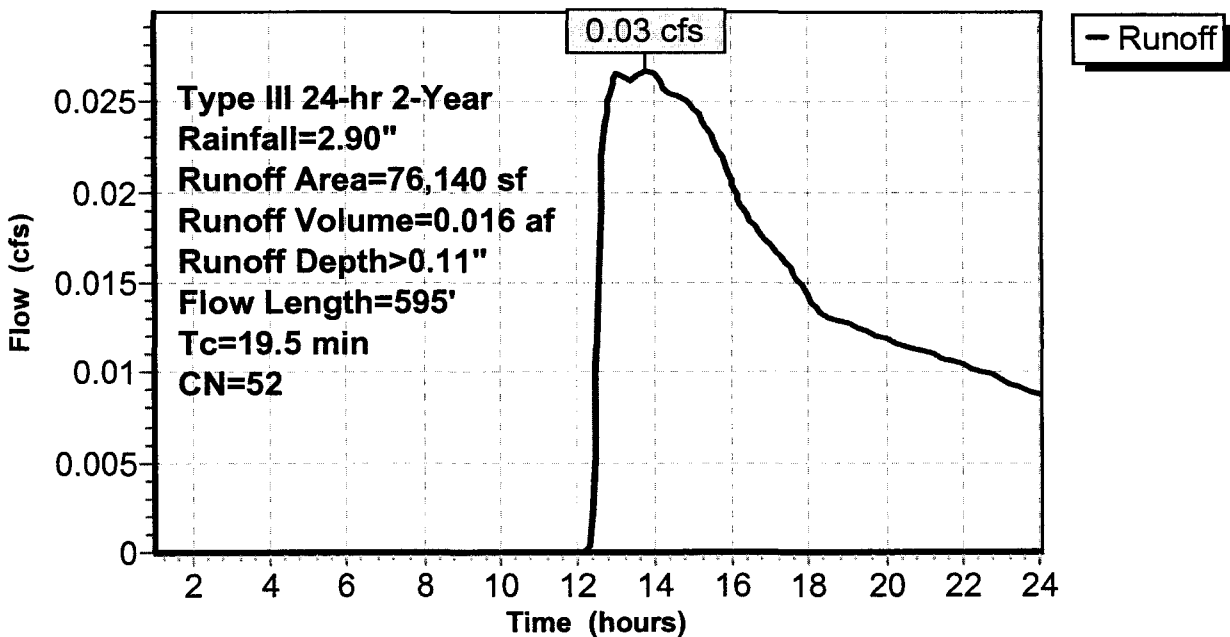
Summary for Subcatchment 2S: Watershed 2S

Runoff = 0.03 cfs @ 13.78 hrs, Volume= 0.016 af, Depth> 0.11"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=2.90"

	Area (sf)	CN	Description
*	66,140	45	Woods/Landscaping, HSG A
*	10,000	98	Existing Gravel Access
	76,140	52	Weighted Average
	66,140		Pervious Area
	10,000		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.7	70	0.0800	0.12		Sheet Flow, Sheet Flow Segment A-B
					Woods: Light underbrush n= 0.400 P2= 2.90"
9.8	525	0.0400	0.90	0.43	Trap/Vee/Rect Channel Flow, Roadside Ditch
					Bot.W=2.00' D=0.20' Z= 2.0 ' / ' Top.W=2.80' n= 0.100
19.5	595	Total			

Subcatchment 2S: Watershed 2S**Hydrograph**

Post-Development

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Type III 24-hr 2-Year Rainfall=2.90"

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Summary for Reach 2R: Roadside Swale (Treatment Calc)

This reach has been created to confirm flow rates and velocities within the roadside swales from Sta 0+00 to Sta 1+50 are below 10 cfs and 1fps respectively.

Inflow Area = 1.748 ac, 13.13% Impervious, Inflow Depth > 0.11" for 2-Year event
Inflow = 0.03 cfs @ 13.78 hrs, Volume= 0.016 af
Outflow = 0.03 cfs @ 14.03 hrs, Volume= 0.015 af, Atten= 0%, Lag= 14.9 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs

Max. Velocity= 0.27 fps, Min. Travel Time= 9.4 min

Avg. Velocity = 0.22 fps, Avg. Travel Time= 11.5 min

Peak Storage= 15 cf @ 13.87 hrs, Average Depth at Peak Storage= 0.05'

Bank-Full Depth= 2.00', Capacity at Bank-Full= 35.66 cfs

2.00' x 2.00' deep channel, n= 0.100

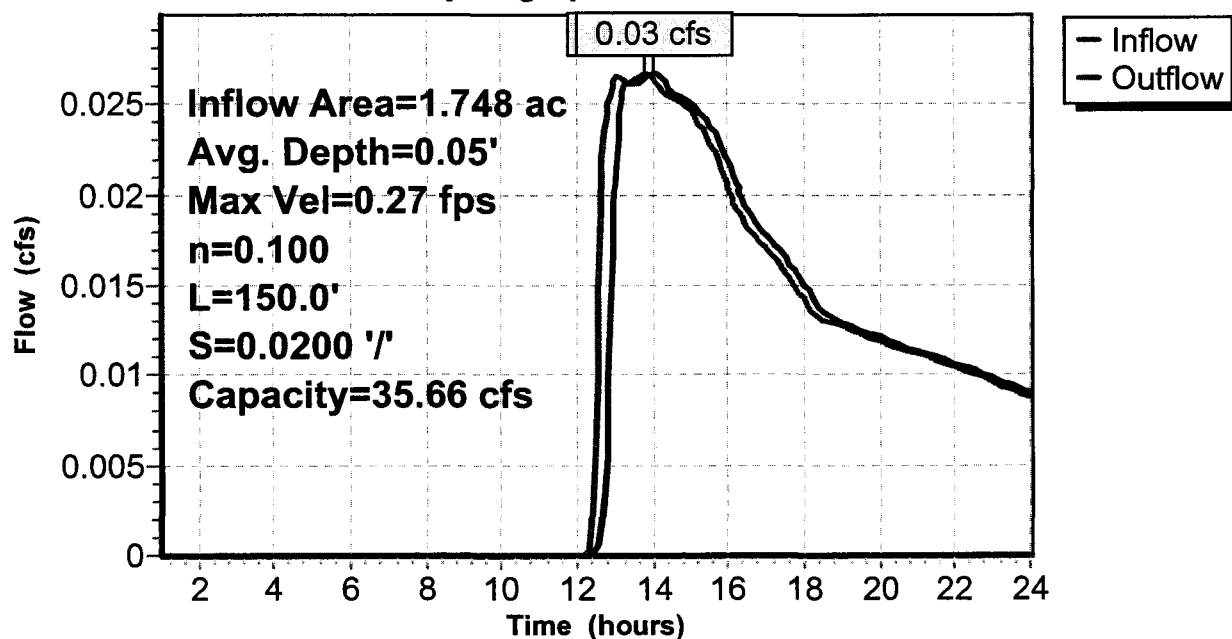
Side Slope Z-value= 3.0 '/' Top Width= 14.00'

Length= 150.0' Slope= 0.0200 '/'

Inlet Invert= 190.00', Outlet Invert= 187.00'

Reach 2R: Roadside Swale (Treatment Calc)

Hydrograph



Post-Development

Type III 24-hr 2-Year Rainfall=2.90"

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Summary for Pond 1P1: Pond 1P1

Inflow Area = 1.574 ac, 15.62% Impervious, Inflow Depth > 0.43" for 2-Year event
Inflow = 0.55 cfs @ 12.17 hrs, Volume= 0.056 af
Outflow = 0.23 cfs @ 12.49 hrs, Volume= 0.056 af, Atten= 59%, Lag= 19.1 min
Primary = 0.23 cfs @ 12.49 hrs, Volume= 0.056 af
Secondary = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 177.99' @ 12.49 hrs Surf.Area= 399 sf Storage= 537 cf

Plug-Flow detention time= 28.0 min calculated for 0.056 af (99% of inflow)
Center-of-Mass det. time= 23.2 min (800.4 - 777.2)

Volume	Invert	Avail.Storage	Storage Description
#1	176.00'	1,740 cf	Custom Stage Data (Prismatic) Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
176.00	140	0	0
178.00	400	540	540
180.00	800	1,200	1,740

Device	Routing	Invert	Outlet Devices
#1	Primary	176.00'	2.5" Vert. Orifice/Grate C= 0.600
#2	Secondary	179.00'	10'-Wide Stone Spillway
			Head (feet) 0.00 0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45
			0.50
			Disch. (cfs) 0.000 0.190 0.620 1.260 3.930 7.720 12.630 18.630
			25.720 33.890 43.140

Primary OutFlow Max=0.23 cfs @ 12.49 hrs HW=177.99' (Free Discharge)
↑1=Orifice/Grate (Orifice Controls 0.23 cfs @ 6.61 fps)

Secondary OutFlow Max=0.00 cfs @ 1.00 hrs HW=176.00' (Free Discharge)
↑2=10'-Wide Stone Spillway (Controls 0.00 cfs)

Post-Development

Prepared by SGC Engineering, LLC

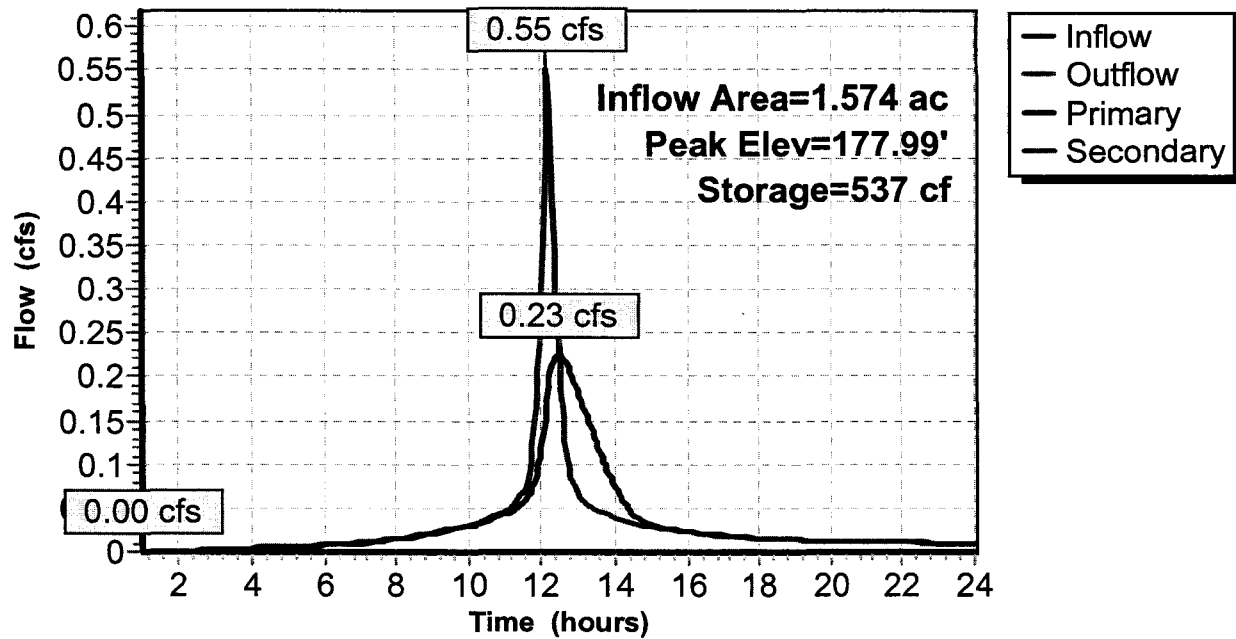
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Type III 24-hr 2-Year Rainfall=2.90"

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Pond 1P1: Pond 1P1

Hydrograph



Post-Development

Type III 24-hr 2-Year Rainfall=2.90"

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Summary for Pond 1P2: Pond 1P2

Inflow Area = 1.895 ac, 25.95% Impervious, Inflow Depth > 0.27" for 2-Year event
 Inflow = 0.21 cfs @ 12.49 hrs, Volume= 0.042 af
 Outflow = 0.11 cfs @ 12.92 hrs, Volume= 0.041 af, Atten= 47%, Lag= 26.2 min
 Primary = 0.11 cfs @ 12.92 hrs, Volume= 0.041 af
 Secondary = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 170.55' @ 12.92 hrs Surf.Area= 316 sf Storage= 226 cf

Plug-Flow detention time= 31.2 min calculated for 0.041 af (98% of inflow)
 Center-of-Mass det. time= 20.9 min (971.1 - 950.2)

Volume	Invert	Avail.Storage	Storage Description
#1	170.00'	2,600 cf	Custom Stage Data (Prismatic) Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
170.00	200	0	0
172.00	625	825	825
174.00	1,150	1,775	2,600

Device	Routing	Invert	Outlet Devices
#1	Primary	170.00'	2.5" Vert. Orifice/Grate C= 0.600
#2	Secondary	173.00'	10'-Wide Stone Spillway
			Head (feet) 0.00 0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50
			Disch. (cfs) 0.000 0.190 0.620 1.260 3.930 7.720 12.630 18.630 25.720 33.890 43.140

Primary OutFlow Max=0.11 cfs @ 12.92 hrs HW=170.55' (Free Discharge)

↑1=Orifice/Grate (Orifice Controls 0.11 cfs @ 3.20 fps)

Secondary OutFlow Max=0.00 cfs @ 1.00 hrs HW=170.00' (Free Discharge)

↑2=10'-Wide Stone Spillway (Controls 0.00 cfs)

Post-Development

Prepared by SGC Engineering, LLC

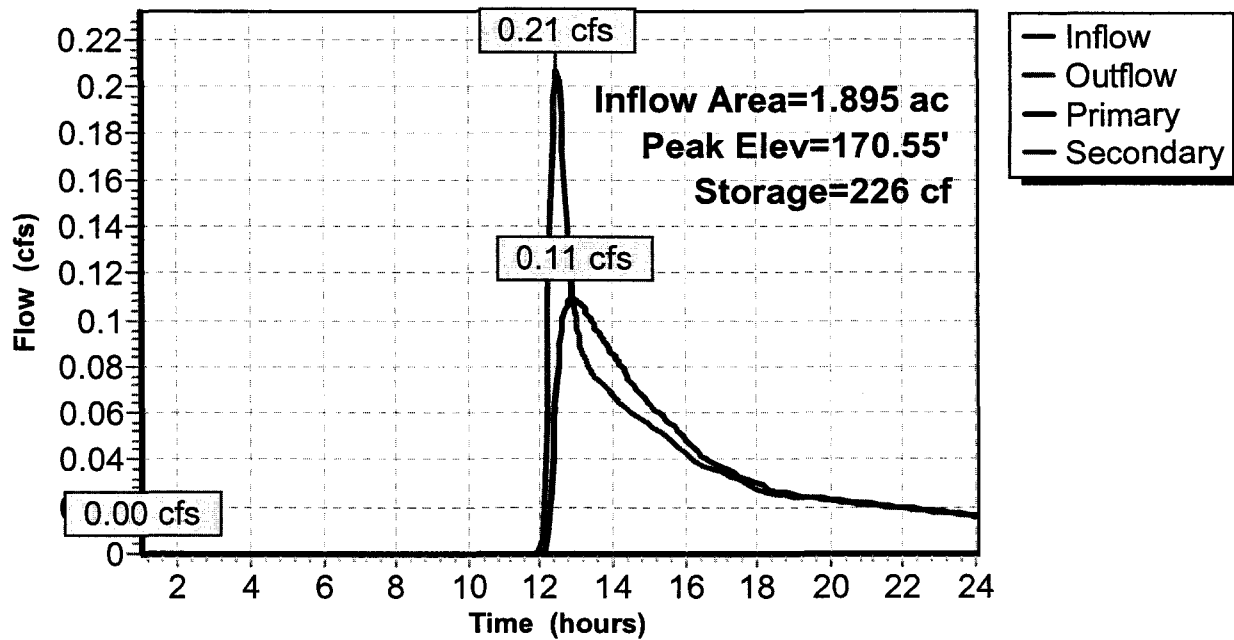
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Type III 24-hr 2-Year Rainfall=2.90"

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Pond 1P2: Pond 1P2

Hydrograph



Post-Development

Type III 24-hr 2-Year Rainfall=2.90"

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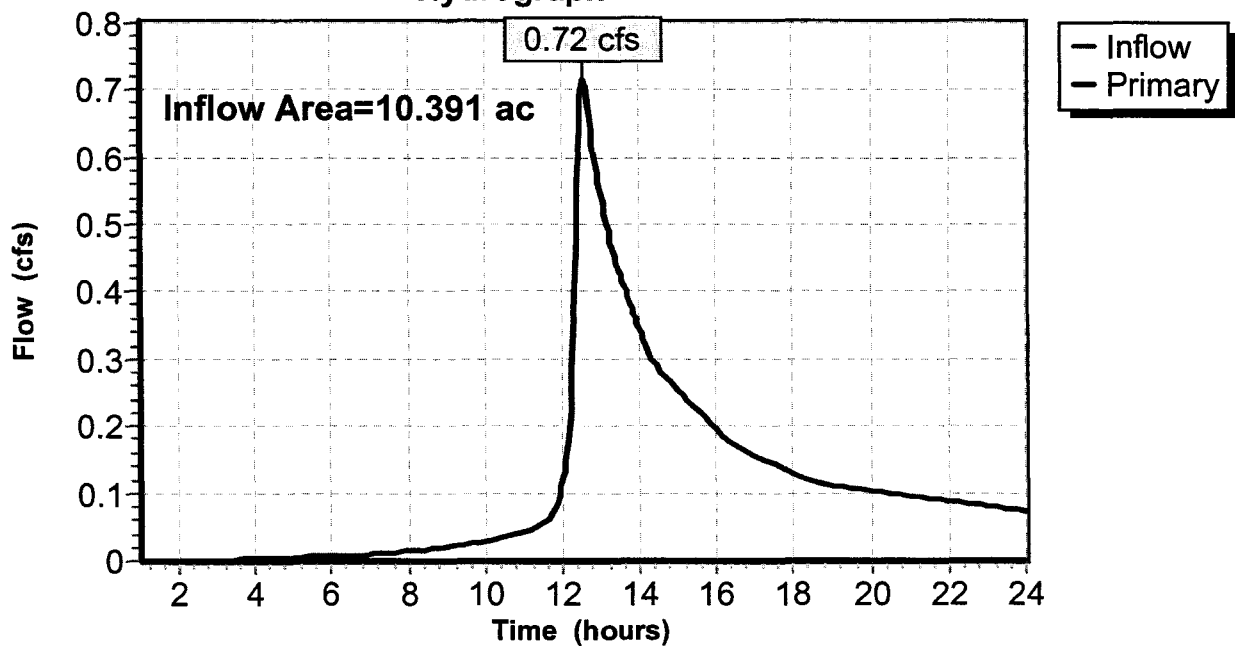
Summary for Link POA 1: Beaver Brook

Inflow Area = 10.391 ac, 7.85% Impervious, Inflow Depth > 0.24" for 2-Year event
Inflow = 0.72 cfs @ 12.58 hrs, Volume= 0.207 af
Primary = 0.72 cfs @ 12.58 hrs, Volume= 0.207 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs

Link POA 1: Beaver Brook

Hydrograph



Post-Development

Type III 24-hr 2-Year Rainfall=2.90"

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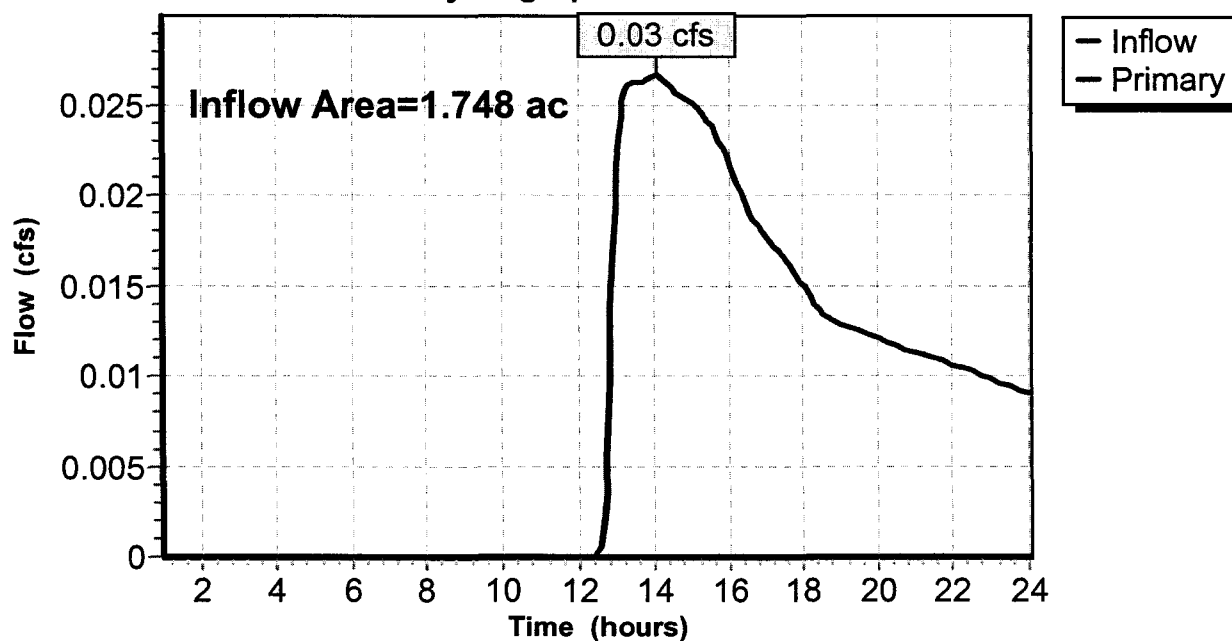
Summary for Link POA 2: Industrial Park Road

Inflow Area = 1.748 ac, 13.13% Impervious, Inflow Depth > 0.10" for 2-Year event
Inflow = 0.03 cfs @ 14.03 hrs, Volume= 0.015 af
Primary = 0.03 cfs @ 14.03 hrs, Volume= 0.015 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs

Link POA 2: Industrial Park Road

Hydrograph



10-YEAR RUNOFF CALCULATIONS

Post-Development

Type III 24-hr 10-Year Rainfall=4.30"

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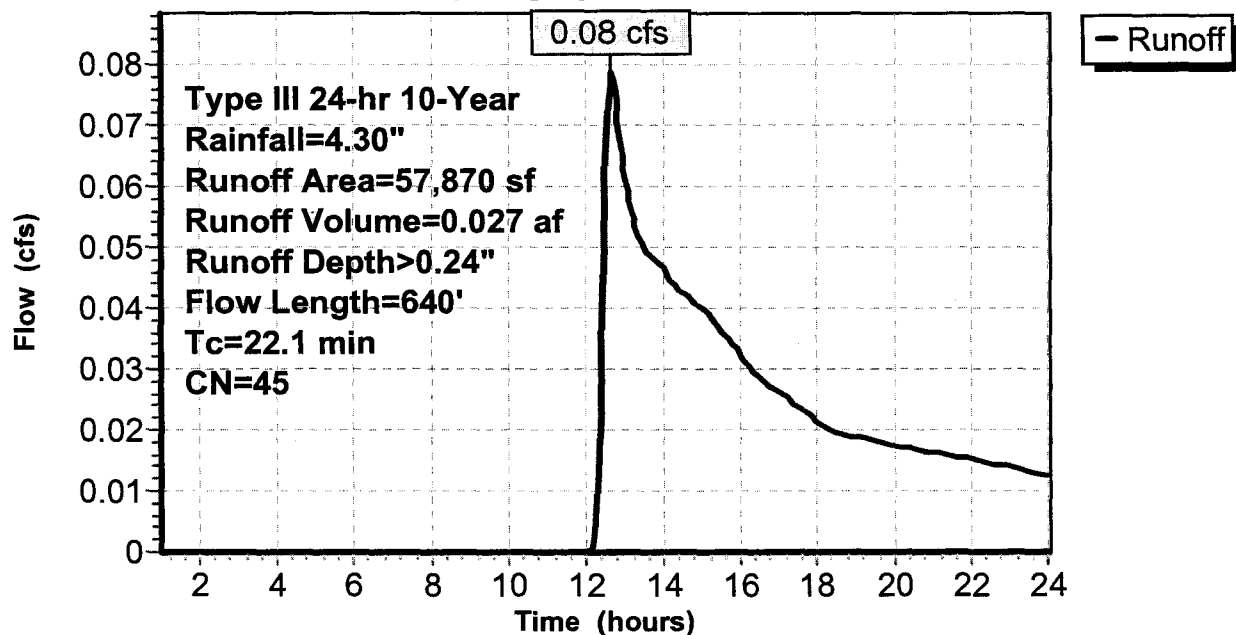
Summary for Subcatchment 1S1B: Watershed 1S1B

Runoff = 0.08 cfs @ 12.65 hrs, Volume= 0.027 af, Depth> 0.24"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.30"

Area (sf)	CN	Description
* 57,870	45	Wood/Landscaping, HSG A
57,870		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	100	0.1200	0.15		Sheet Flow, Sheet Flow Segment A-B Woods: Light underbrush n= 0.400 P2= 2.90"
0.9	75	0.0800	1.41		Shallow Concentrated Flow, Shallow Flow, Segment B-C Woodland Kv= 5.0 fps
4.6	250	0.0400	0.90	0.43	Trap/Vee/Rect Channel Flow, Roadside Ditch, C-D Bot.W=2.00' D=0.20' Z= 2.0 '/' Top.W=2.80' n= 0.100
5.6	215	0.0200	0.63	0.30	Trap/Vee/Rect Channel Flow, Roadside Ditch, D-E Bot.W=2.00' D=0.20' Z= 2.0 '/' Top.W=2.80' n= 0.100
22.1	640	Total			

Subcatchment 1S1B: Watershed 1S1B**Hydrograph**

Post-Development

Type III 24-hr 10-Year Rainfall=4.30"

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Summary for Subcatchment 1S2: Watershed 1S2

Runoff = 1.06 cfs @ 12.31 hrs, Volume= 0.135 af, Depth> 0.85"

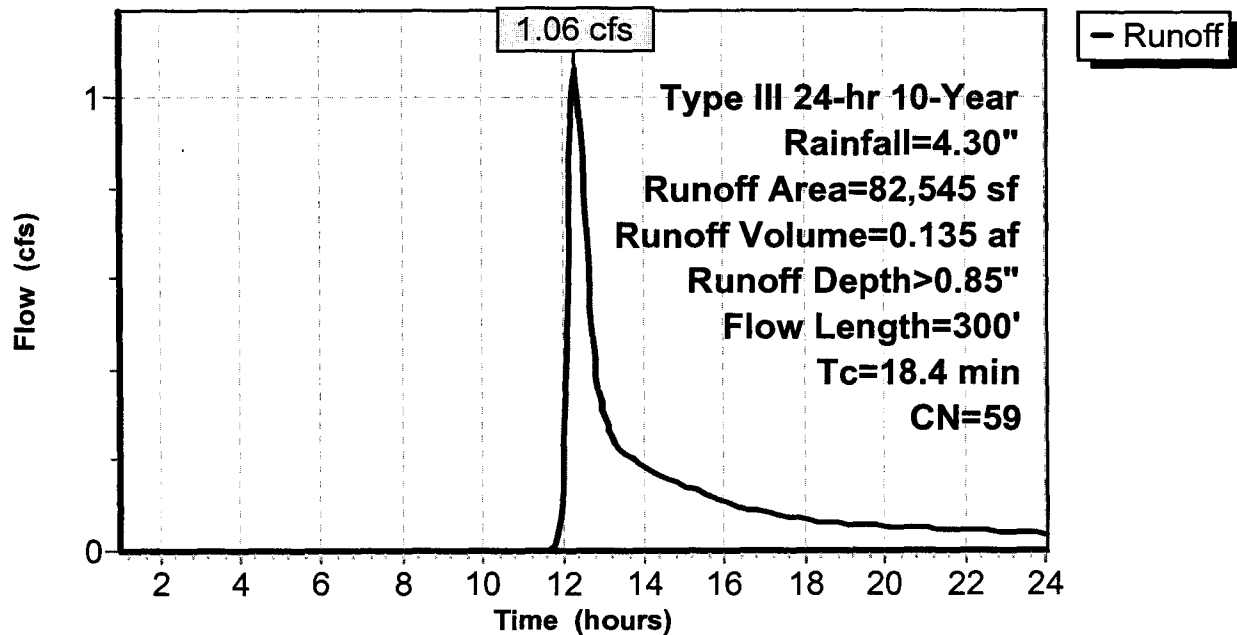
Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.30"

	Area (sf)	CN	Description
*	61,125	45	Woods/Landscaping, HSG A
*	21,420	98	Proposed Impervious Area
	82,545	59	Weighted Average
	61,125		Pervious Area
	21,420		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.0	100	0.0800	0.13		Sheet Flow, Sheet Flow Segment A-B Woods: Light underbrush n= 0.400 P2= 2.90"
1.1	85	0.0700	1.32		Shallow Concentrated Flow, Shallow Flow, Segment B-C Woodland Kv= 5.0 fps
4.3	115	0.0100	0.45	0.22	Trap/Vee/Rect Channel Flow, Grassed Swale Bot.W=2.00' D=0.20' Z= 2.0 ' /' Top.W=2.80' n= 0.100
18.4	300	Total			

Subcatchment 1S2: Watershed 1S2

Hydrograph



Post-Development

Type III 24-hr 10-Year Rainfall=4.30"

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Summary for Subcatchment 1S3: Watershed 1S3

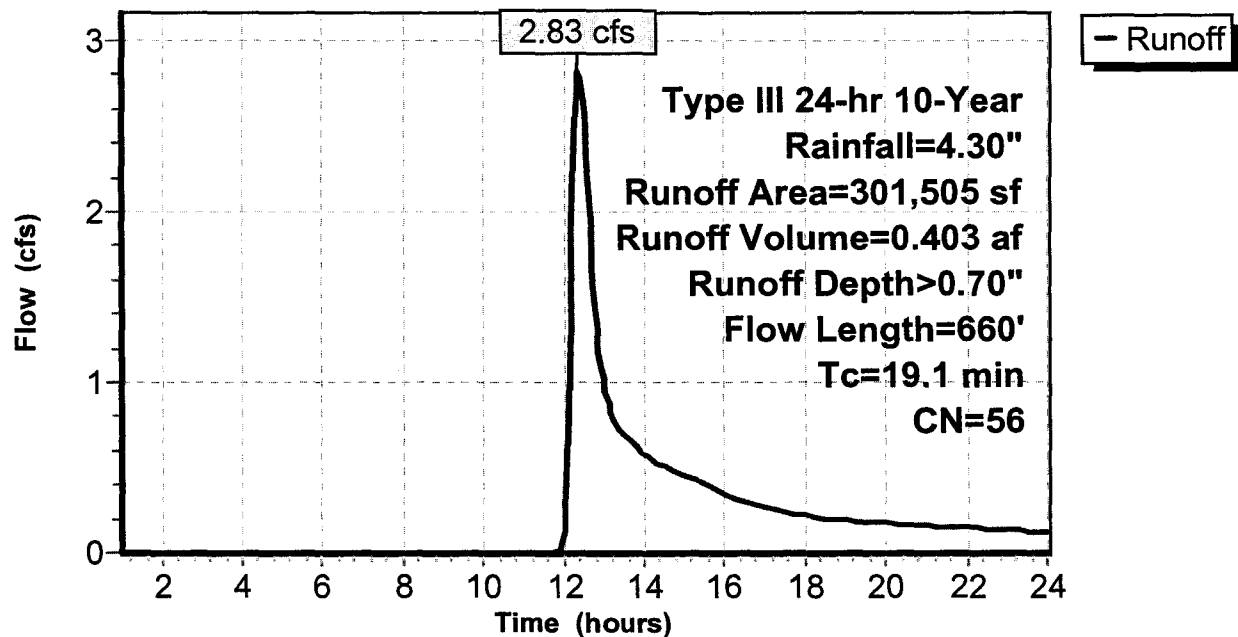
Runoff = 2.83 cfs @ 12.35 hrs, Volume= 0.403 af, Depth> 0.70"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs

Type III 24-hr 10-Year Rainfall=4.30"

	Area (sf)	CN	Description
*	163,250	45	Woods/Grass HSG A
*	58,280	65	Woods/Grass HSG B
*	76,575	70	Forested Wetlands/Flood Plain
*	3,400	98	Proposed Impervious Area
	301,505	56	Weighted Average
	298,105		Pervious Area
	3,400		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.8	100	0.1000	0.14		Sheet Flow, Sheet Flow Segment A-B Woods: Light underbrush n= 0.400 P2= 2.90"
4.0	340	0.0800	1.41		Shallow Concentrated Flow, Shallow Flow, Segment B-C Woodland Kv= 5.0 fps
3.3	220	0.0500	1.12		Shallow Concentrated Flow, Shallow Flow, Segment C-D Woodland Kv= 5.0 fps
19.1	660	Total			

Subcatchment 1S3: Watershed 1S3**Hydrograph**

Post-Development

Type III 24-hr 10-Year Rainfall=4.30"

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Summary for Subcatchment 2S: Watershed 2S

Runoff = 0.43 cfs @ 12.43 hrs, Volume= 0.074 af, Depth> 0.51"

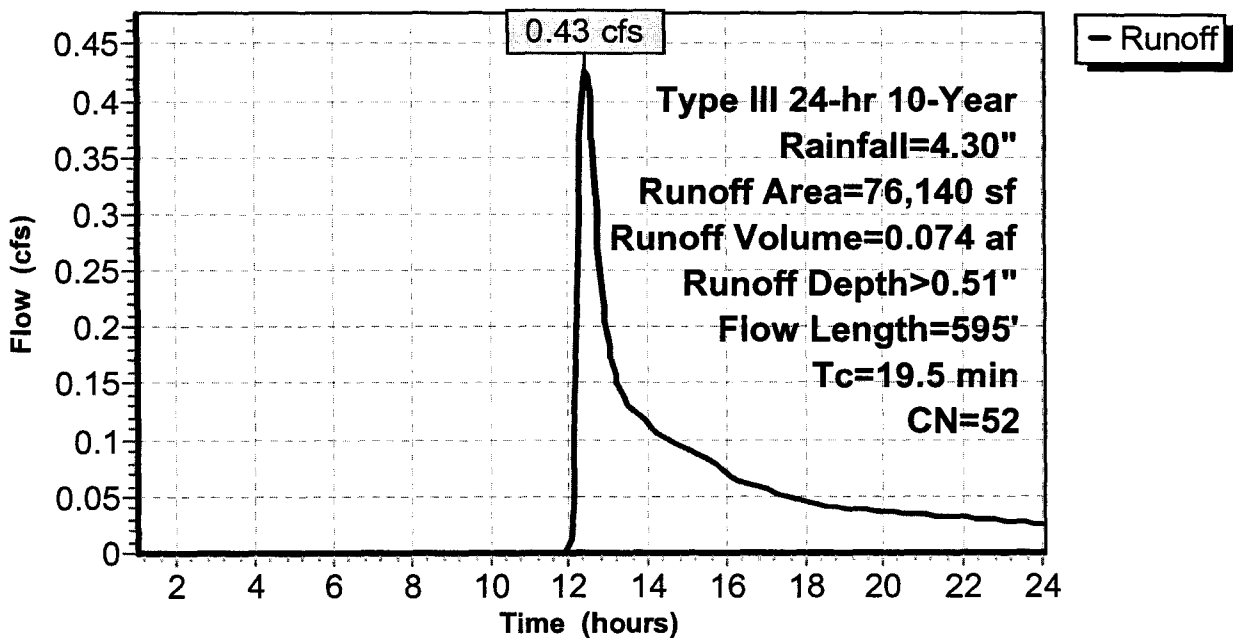
Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.30"

	Area (sf)	CN	Description
*	66,140	45	Woods/Landscaping, HSG A
*	10,000	98	Existing Gravel Access
	76,140	52	Weighted Average
	66,140		Pervious Area
	10,000		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.7	70	0.0800	0.12		Sheet Flow, Sheet Flow Segment A-B
9.8	525	0.0400	0.90	0.43	Woods: Light underbrush n= 0.400 P2= 2.90"
					Trap/Vee/Rect Channel Flow, Roadside Ditch
					Bot.W=2.00' D=0.20' Z= 2.0 ' Top.W=2.80' n= 0.100
19.5	595	Total			

Subcatchment 2S: Watershed 2S

Hydrograph



Post-Development

Type III 24-hr 10-Year Rainfall=4.30"

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Summary for Reach 2R: Roadside Swale (Treatment Calc)

This reach has been created to confirm flow rates and velocities within the roadside swales from Sta 0+00 to Sta 1+50 are below 10 cfs and 1fps respectively.

Inflow Area = 1.748 ac, 13.13% Impervious, Inflow Depth > 0.51" for 10-Year event
Inflow = 0.43 cfs @ 12.43 hrs, Volume= 0.074 af
Outflow = 0.42 cfs @ 12.55 hrs, Volume= 0.074 af, Atten= 2%, Lag= 7.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs

Max. Velocity= 0.67 fps, Min. Travel Time= 3.7 min

Avg. Velocity = 0.35 fps, Avg. Travel Time= 7.1 min

Peak Storage= 94 cf @ 12.49 hrs, Average Depth at Peak Storage= 0.23'

Bank-Full Depth= 2.00', Capacity at Bank-Full= 35.66 cfs

2.00' x 2.00' deep channel, n= 0.100

Side Slope Z-value= 3.0 '/' Top Width= 14.00'

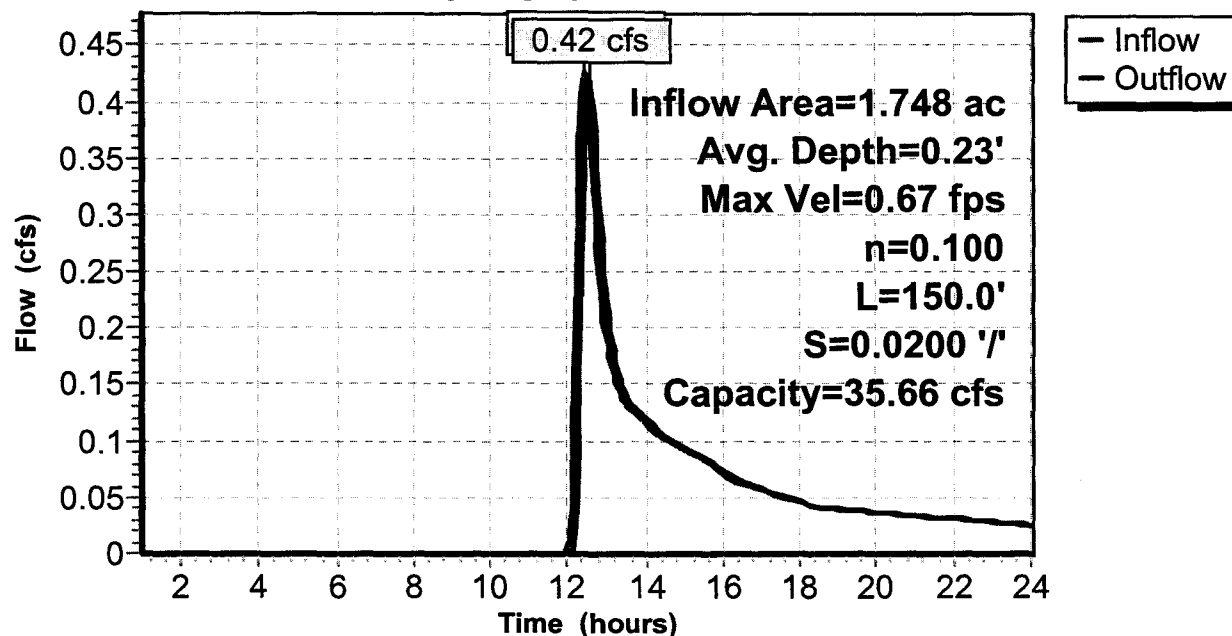
Length= 150.0' Slope= 0.0200 '/'

Inlet Invert= 190.00', Outlet Invert= 187.00'



Reach 2R: Roadside Swale (Treatment Calc)

Hydrograph



Post-Development

Type III 24-hr 10-Year Rainfall=4.30"

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Summary for Pond 1P1: Pond 1P1

Inflow Area = 1.574 ac, 15.62% Impervious, Inflow Depth > 0.84" for 10-Year event
Inflow = 0.83 cfs @ 12.17 hrs, Volume= 0.110 af
Outflow = 0.27 cfs @ 12.65 hrs, Volume= 0.109 af, Atten= 68%, Lag= 28.9 min
Primary = 0.27 cfs @ 12.65 hrs, Volume= 0.109 af
Secondary = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 178.74' @ 12.65 hrs Surf.Area= 548 sf Storage= 984 cf

Plug-Flow detention time= 33.6 min calculated for 0.109 af (99% of inflow)
Center-of-Mass det. time= 29.6 min (842.5 - 813.0)

Volume	Invert	Avail.Storage	Storage Description
#1	176.00'	1,740 cf	Custom Stage Data (Prismatic) Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
176.00	140	0	0
178.00	400	540	540
180.00	800	1,200	1,740

Device	Routing	Invert	Outlet Devices
#1	Primary	176.00'	2.5" Vert. Orifice/Grate C= 0.600
#2	Secondary	179.00'	10'-Wide Stone Spillway
			Head (feet) 0.00 0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50
			Disch. (cfs) 0.000 0.190 0.620 1.260 3.930 7.720 12.630 18.630 25.720 33.890 43.140

Primary OutFlow Max=0.27 cfs @ 12.65 hrs HW=178.74' (Free Discharge)
↑1=Orifice/Grate (Orifice Controls 0.27 cfs @ 7.82 fps)

Secondary OutFlow Max=0.00 cfs @ 1.00 hrs HW=176.00' (Free Discharge)
↑2=10'-Wide Stone Spillway (Controls 0.00 cfs)

Post-Development

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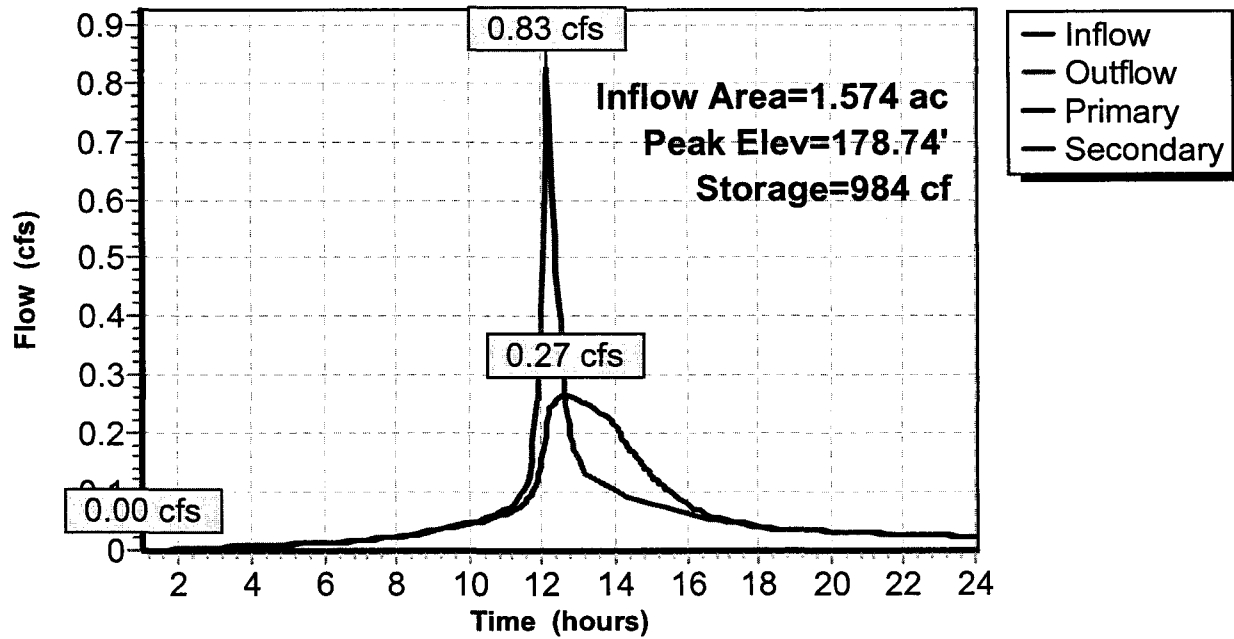
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Type III 24-hr 10-Year Rainfall=4.30"

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Pond 1P1: Pond 1P1

Hydrograph



Post-Development

Type III 24-hr 10-Year Rainfall=4.30"

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Summary for Pond 1P2: Pond 1P2

Inflow Area = 1.895 ac, 25.95% Impervious, Inflow Depth > 0.85" for 10-Year event
Inflow = 1.06 cfs @ 12.31 hrs, Volume= 0.135 af
Outflow = 0.27 cfs @ 13.11 hrs, Volume= 0.133 af, Atten= 74%, Lag= 47.7 min
Primary = 0.27 cfs @ 13.11 hrs, Volume= 0.133 af
Secondary = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 172.89' @ 13.11 hrs Surf.Area= 858 sf Storage= 1,613 cf

Plug-Flow detention time= 63.4 min calculated for 0.133 af (99% of inflow)
Center-of-Mass det. time= 57.5 min (957.4 - 899.8)

Volume	Invert	Avail.Storage	Storage Description
#1	170.00'	2,600 cf	Custom Stage Data (Prismatic) Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
170.00	200	0	0
172.00	625	825	825
174.00	1,150	1,775	2,600

Device	Routing	Invert	Outlet Devices
#1	Primary	170.00'	2.5" Vert. Orifice/Grate C= 0.600
#2	Secondary	173.00'	10'-Wide Stone Spillway
			Head (feet) 0.00 0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45
			0.50
			Disch. (cfs) 0.000 0.190 0.620 1.260 3.930 7.720 12.630 18.630
			25.720 33.890 43.140

Primary OutFlow Max=0.27 cfs @ 13.11 hrs HW=172.89' (Free Discharge)
↑1=Orifice/Grate (Orifice Controls 0.27 cfs @ 8.03 fps)

Secondary OutFlow Max=0.00 cfs @ 1.00 hrs HW=170.00' (Free Discharge)
↑2=10'-Wide Stone Spillway (Controls 0.00 cfs)

Post-Development

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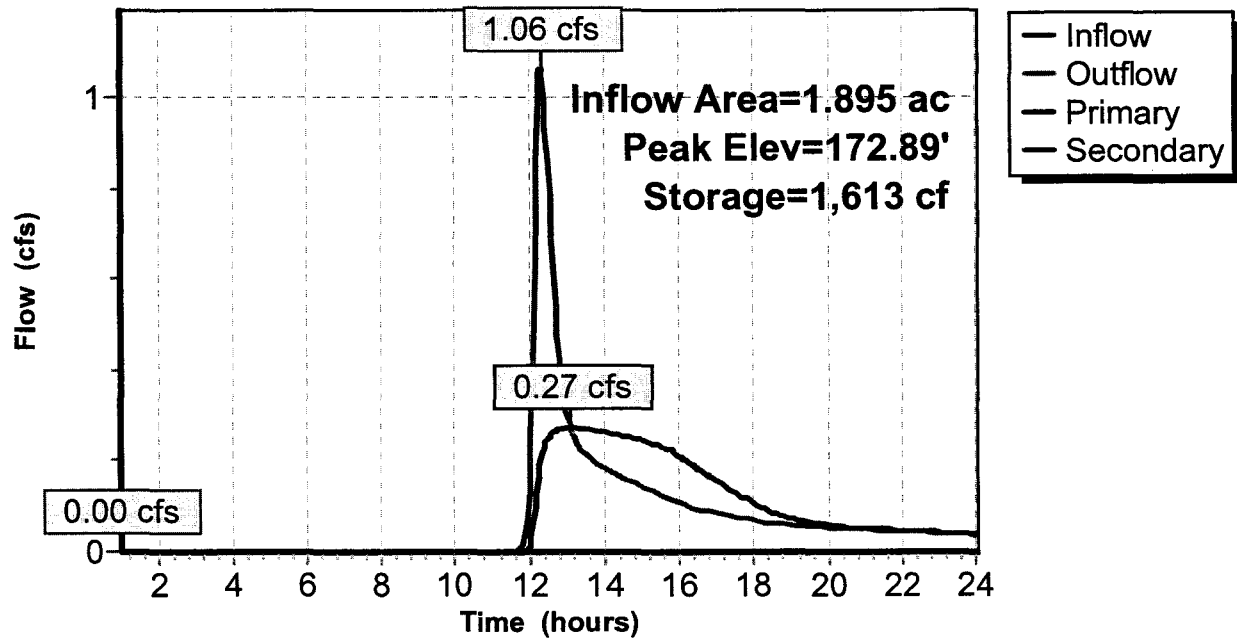
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Type III 24-hr 10-Year Rainfall=4.30"

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Pond 1P2: Pond 1P2

Hydrograph



Post-Development

Type III 24-hr 10-Year Rainfall=4.30"

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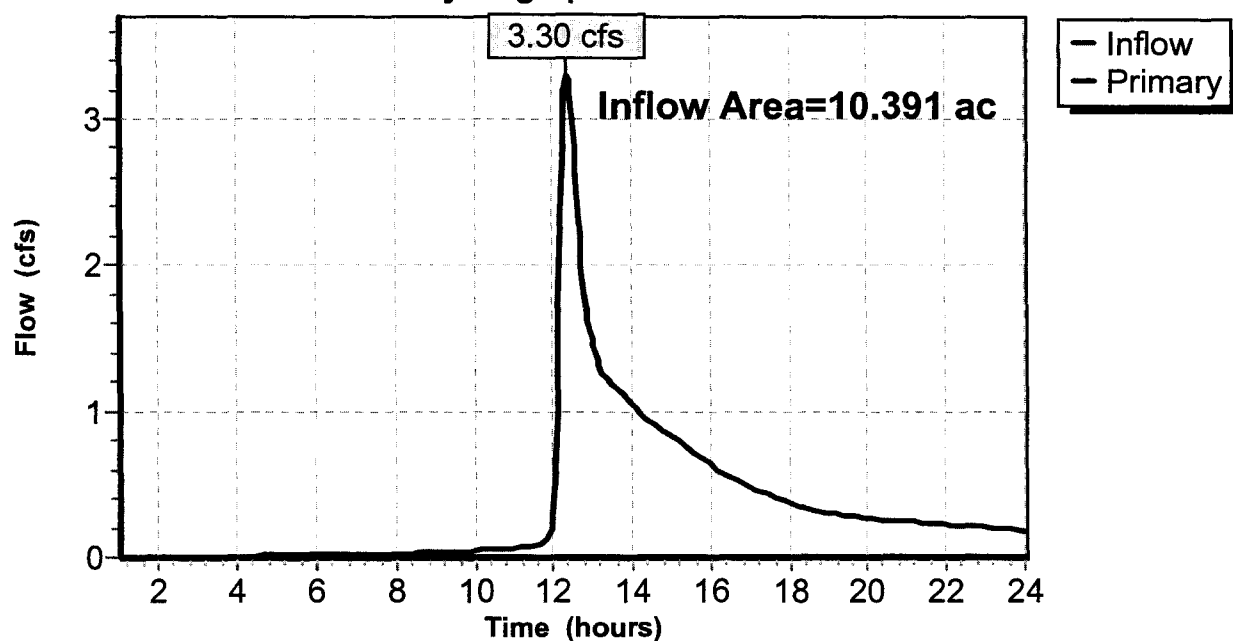
Summary for Link POA 1: Beaver Brook

Inflow Area = 10.391 ac, 7.85% Impervious, Inflow Depth > 0.75" for 10-Year event
Inflow = 3.30 cfs @ 12.36 hrs, Volume= 0.646 af
Primary = 3.30 cfs @ 12.36 hrs, Volume= 0.646 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs

Link POA 1: Beaver Brook

Hydrograph



Post-Development

Type III 24-hr 10-Year Rainfall=4.30"

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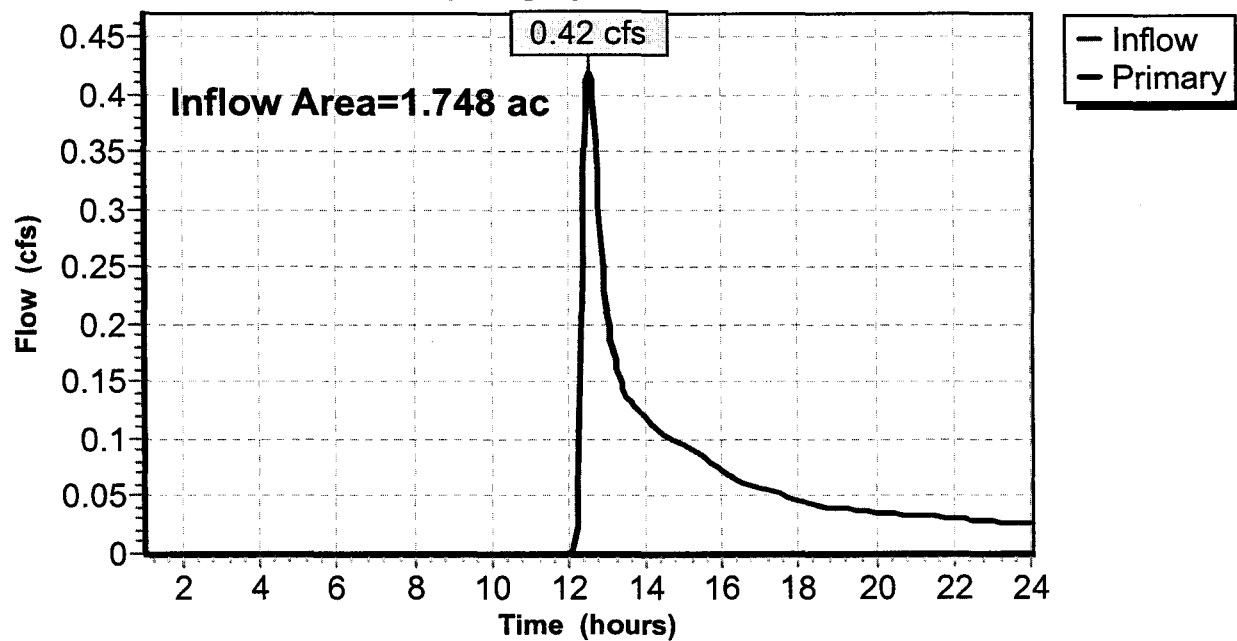
Summary for Link POA 2: Industrial Park Road

Inflow Area = 1.748 ac, 13.13% Impervious, Inflow Depth > 0.51" for 10-Year event
Inflow = 0.42 cfs @ 12.55 hrs, Volume= 0.074 af
Primary = 0.42 cfs @ 12.55 hrs, Volume= 0.074 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs

Link POA 2: Industrial Park Road

Hydrograph



50-YEAR RUNOFF CALCULATIONS

Post-Development

Type III 24-hr 50-Year Rainfall=5.70"

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Page 1

Time span=1.00-24.00 hrs, dt=0.05 hrs, 461 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S1A: Watershed 1S1A Runoff Area=10,715 sf 100.00% Impervious Runoff Depth>5.45"
Flow Length=615' Tc=13.0 min CN=98 Runoff=1.10 cfs 0.112 af

Subcatchment 1S1B: Watershed 1S1B Runoff Area=57,870 sf 0.00% Impervious Runoff Depth>0.68"
Flow Length=640' Tc=22.1 min CN=45 Runoff=0.42 cfs 0.075 af

Subcatchment 1S2: Watershed 1S2 Runoff Area=82,545 sf 25.95% Impervious Runoff Depth>1.64"
Flow Length=300' Tc=18.4 min CN=59 Runoff=2.33 cfs 0.259 af

Subcatchment 1S3: Watershed 1S3 Runoff Area=301,505 sf 1.13% Impervious Runoff Depth>1.41"
Flow Length=660' Tc=19.1 min CN=56 Runoff=6.93 cfs 0.816 af

Subcatchment 2S: Watershed 2S Runoff Area=76,140 sf 13.13% Impervious Runoff Depth>1.13"
Flow Length=595' Tc=19.5 min CN=52 Runoff=1.27 cfs 0.164 af

Reach 2R: Roadside Swale (Treatment Calc) Avg. Depth=0.42' Max Vel=0.92 fps Inflow=1.27 cfs 0.164 af
n=0.100 L=150.0' S=0.0200 '/' Capacity=35.66 cfs Outflow=1.25 cfs 0.164 af

Pond 1P1: Pond 1P1 Peak Elev=179.12' Storage=1,212 cf Inflow=1.23 cfs 0.187 af
Primary=0.29 cfs 0.162 af Secondary=0.87 cfs 0.024 af Outflow=1.16 cfs 0.186 af

Pond 1P2: Pond 1P2 Peak Elev=173.17' Storage=1,867 cf Inflow=2.33 cfs 0.259 af
Primary=0.29 cfs 0.188 af Secondary=2.59 cfs 0.069 af Outflow=2.88 cfs 0.257 af

Link POA 1: Beaver Brook Inflow=10.75 cfs 1.259 af
Primary=10.75 cfs 1.259 af

Link POA 2: Industrial Park Road Inflow=1.25 cfs 0.164 af
Primary=1.25 cfs 0.164 af

Total Runoff Area = 12.139 ac Runoff Volume = 1.426 af Average Runoff Depth = 1.41"
91.39% Pervious = 11.094 ac 8.61% Impervious = 1.045 ac

Post-Development

Type III 24-hr 50-Year Rainfall=5.70"

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Summary for Subcatchment 1S1A: Watershed 1S1A

Runoff = 1.10 cfs @ 12.17 hrs, Volume= 0.112 af, Depth> 5.45"

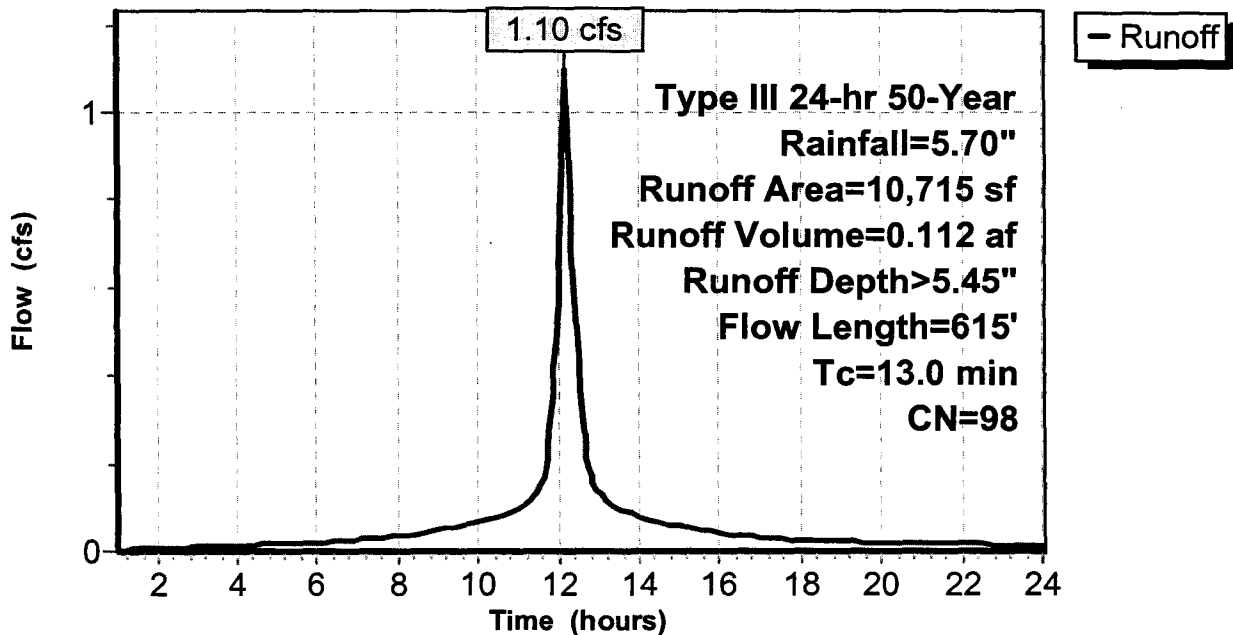
Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=5.70"

Area (sf)	CN	Description
* 10,715	98	Proposed Impervious Area
10,715		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	400	0.0400	0.90	0.43	Trap/Vee/Rect Channel Flow, Roadside Ditch, A-B Bot.W=2.00' D=0.20' Z= 2.0 '/' Top.W=2.80' n= 0.100
5.6	215	0.0200	0.63	0.30	Trap/Vee/Rect Channel Flow, Roadside Ditch, D-E Bot.W=2.00' D=0.20' Z= 2.0 '/' Top.W=2.80' n= 0.100
13.0	615	Total			

Subcatchment 1S1A: Watershed 1S1A

Hydrograph



Post-Development

Type III 24-hr 50-Year Rainfall=5.70"

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Summary for Subcatchment 1S1B: Watershed 1S1B

Runoff = 0.42 cfs @ 12.47 hrs, Volume= 0.075 af, Depth> 0.68"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs

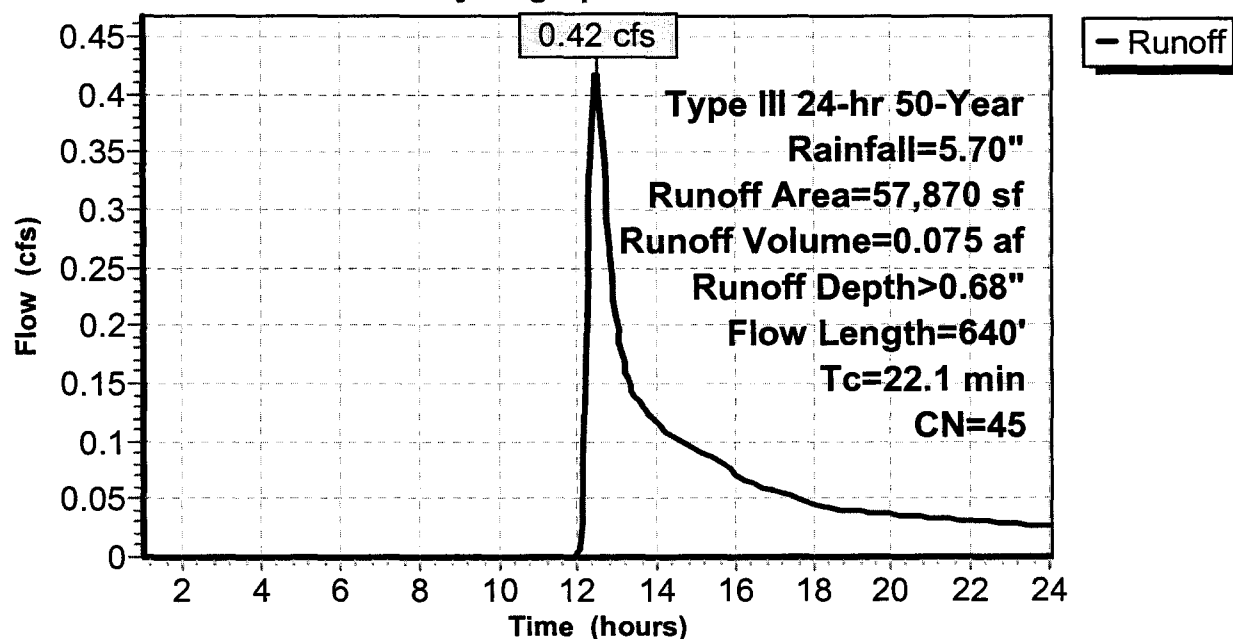
Type III 24-hr 50-Year Rainfall=5.70"

Area (sf)	CN	Description
* 57,870	45	Wood/Landscaping, HSG A
57,870		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	100	0.1200	0.15		Sheet Flow, Sheet Flow Segment A-B Woods: Light underbrush n= 0.400 P2= 2.90"
0.9	75	0.0800	1.41		Shallow Concentrated Flow, Shallow Flow, Segment B-C Woodland Kv= 5.0 fps
4.6	250	0.0400	0.90	0.43	Trap/Vee/Rect Channel Flow, Roadside Ditch, C-D Bot.W=2.00' D=0.20' Z= 2.0 ' Top.W=2.80' n= 0.100
5.6	215	0.0200	0.63	0.30	Trap/Vee/Rect Channel Flow, Roadside Ditch, D-E Bot.W=2.00' D=0.20' Z= 2.0 ' Top.W=2.80' n= 0.100
22.1	640	Total			

Subcatchment 1S1B: Watershed 1S1B

Hydrograph



Post-Development

Type III 24-hr 50-Year Rainfall=5.70"

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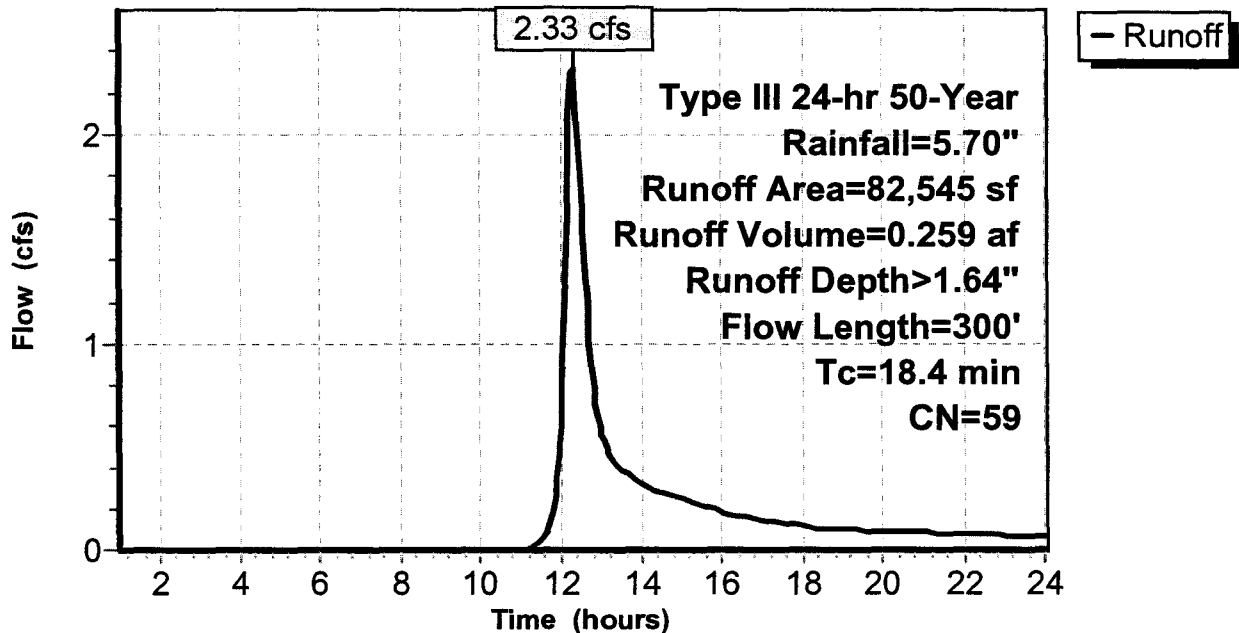
Summary for Subcatchment 1S2: Watershed 1S2

Runoff = 2.33 cfs @ 12.28 hrs, Volume= 0.259 af, Depth> 1.64"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=5.70"

	Area (sf)	CN	Description
*	61,125	45	Woods/Landscaping, HSG A
*	21,420	98	Proposed Impervious Area
	82,545	59	Weighted Average
	61,125		Pervious Area
	21,420		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.0	100	0.0800	0.13		Sheet Flow, Sheet Flow Segment A-B Woods: Light underbrush n= 0.400 P2= 2.90"
1.1	85	0.0700	1.32		Shallow Concentrated Flow, Shallow Flow, Segment B-C Woodland Kv= 5.0 fps
4.3	115	0.0100	0.45	0.22	Trap/Vee/Rect Channel Flow, Grassed Swale Bot.W=2.00' D=0.20' Z= 2.0 ' Top.W=2.80' n= 0.100
18.4	300	Total			

Subcatchment 1S2: Watershed 1S2**Hydrograph**

Post-Development

Type III 24-hr 50-Year Rainfall=5.70"

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Summary for Subcatchment 1S3: Watershed 1S3

Runoff = 6.93 cfs @ 12.30 hrs, Volume= 0.816 af, Depth> 1.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs

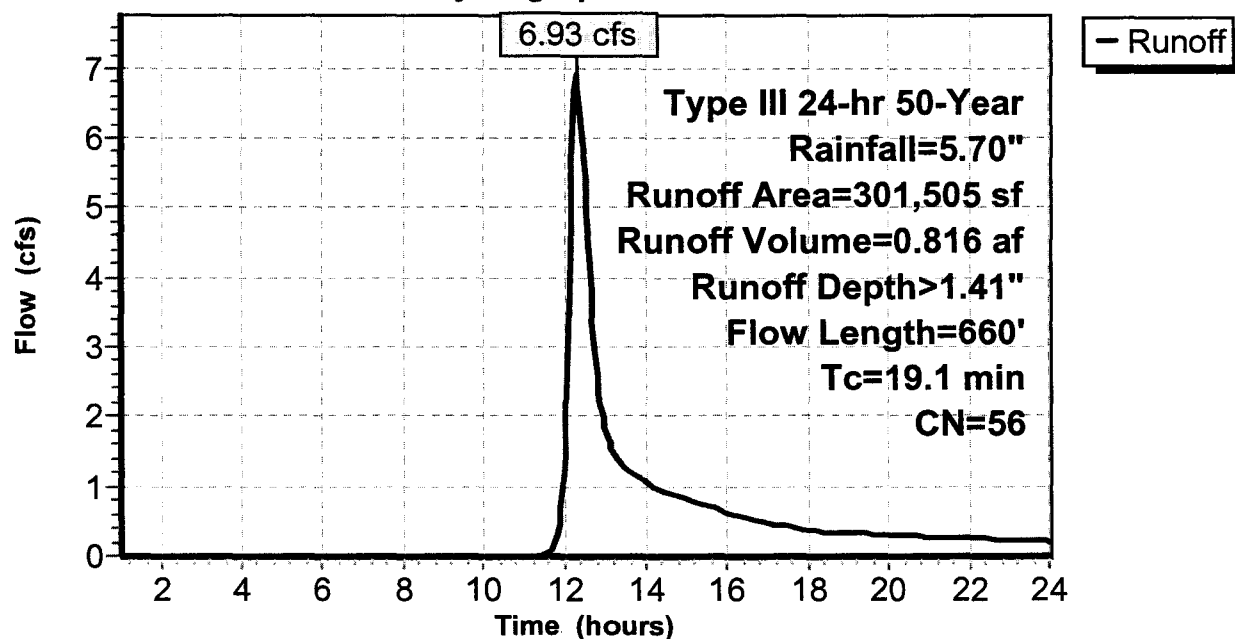
Type III 24-hr 50-Year Rainfall=5.70"

Area (sf)	CN	Description
* 163,250	45	Woods/Grass HSG A
* 58,280	65	Woods/Grass HSG B
* 76,575	70	Forested Wetlands/Flood Plain
* 3,400	98	Proposed Impervious Area
301,505	56	Weighted Average
298,105		Pervious Area
3,400		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.8	100	0.1000	0.14		Sheet Flow, Sheet Flow Segment A-B Woods: Light underbrush n= 0.400 P2= 2.90"
4.0	340	0.0800	1.41		Shallow Concentrated Flow, Shallow Flow, Segment B-C Woodland Kv= 5.0 fps
3.3	220	0.0500	1.12		Shallow Concentrated Flow, Shallow Flow, Segment C-D Woodland Kv= 5.0 fps
19.1	660	Total			

Subcatchment 1S3: Watershed 1S3

Hydrograph



Post-Development

Type III 24-hr 50-Year Rainfall=5.70"

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Summary for Subcatchment 2S: Watershed 2S

Runoff = 1.27 cfs @ 12.33 hrs, Volume= 0.164 af, Depth> 1.13"

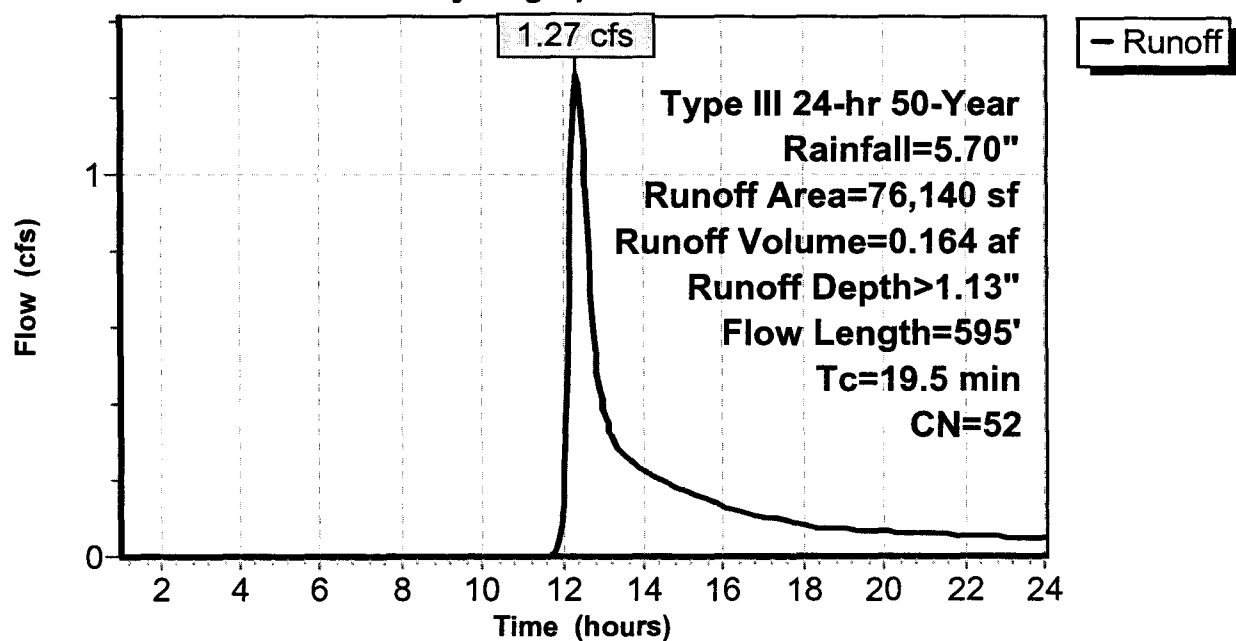
Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=5.70"

	Area (sf)	CN	Description
*	66,140	45	Woods/Landscaping, HSG A
*	10,000	98	Existing Gravel Access
	76,140	52	Weighted Average
	66,140		Pervious Area
	10,000		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.7	70	0.0800	0.12		Sheet Flow, Sheet Flow Segment A-B
					Woods: Light underbrush n= 0.400 P2= 2.90"
9.8	525	0.0400	0.90	0.43	Trap/Vee/Rect Channel Flow, Roadside Ditch
					Bot.W=2.00' D=0.20' Z= 2.0 ' Top.W=2.80' n= 0.100
19.5	595	Total			

Subcatchment 2S: Watershed 2S

Hydrograph



Post-Development

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Type III 24-hr 50-Year Rainfall=5.70"

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Summary for Reach 2R: Roadside Swale (Treatment Calc)

This reach has been created to confirm flow rates and velocities within the roadside swales from Sta 0+00 to Sta 1+50 are below 10 cfs and 1fps respectively.

Inflow Area = 1.748 ac, 13.13% Impervious, Inflow Depth > 1.13" for 50-Year event
Inflow = 1.27 cfs @ 12.33 hrs, Volume= 0.164 af
Outflow = 1.25 cfs @ 12.42 hrs, Volume= 0.164 af, Atten= 1%, Lag= 5.1 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.92 fps, Min. Travel Time= 2.7 min
Avg. Velocity = 0.44 fps, Avg. Travel Time= 5.7 min

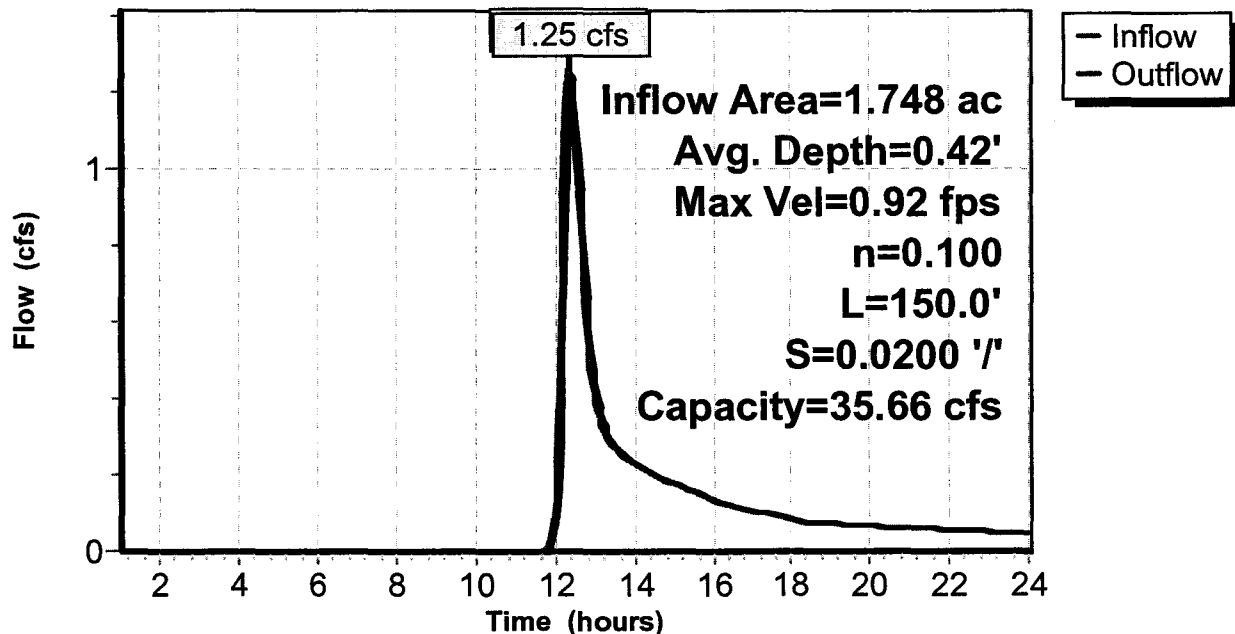
Peak Storage= 203 cf @ 12.37 hrs, Average Depth at Peak Storage= 0.42'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 35.66 cfs

2.00' x 2.00' deep channel, n= 0.100
Side Slope Z-value= 3.0 '/' Top Width= 14.00'
Length= 150.0' Slope= 0.0200 '/'
Inlet Invert= 190.00', Outlet Invert= 187.00'



Reach 2R: Roadside Swale (Treatment Calc)

Hydrograph



Post-Development

Type III 24-hr 50-Year Rainfall=5.70"

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Summary for Pond 1P1: Pond 1P1

Inflow Area = 1.574 ac, 15.62% Impervious, Inflow Depth > 1.42" for 50-Year event
Inflow = 1.23 cfs @ 12.20 hrs, Volume= 0.187 af
Outflow = 1.16 cfs @ 12.36 hrs, Volume= 0.186 af, Atten= 6%, Lag= 9.3 min
Primary = 0.29 cfs @ 12.36 hrs, Volume= 0.162 af
Secondary = 0.87 cfs @ 12.36 hrs, Volume= 0.024 af

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 179.12' @ 12.36 hrs Surf.Area= 624 sf Storage= 1,212 cf

Plug-Flow detention time= 35.1 min calculated for 0.186 af (99% of inflow)
Center-of-Mass det. time= 31.9 min (857.0 - 825.1)

Volume	Invert	Avail.Storage	Storage Description
#1	176.00'	1,740 cf	Custom Stage Data (Prismatic) Listed below
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
176.00	140	0	0
178.00	400	540	540
180.00	800	1,200	1,740

Device	Routing	Invert	Outlet Devices
#1	Primary	176.00'	2.5" Vert. Orifice/Grate C= 0.600
#2	Secondary	179.00'	10'-Wide Stone Spillway
Head (feet) 0.00 0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50			
Disch. (cfs) 0.000 0.190 0.620 1.260 3.930 7.720 12.630 18.630 25.720 33.890 43.140			

Primary OutFlow Max=0.28 cfs @ 12.36 hrs HW=179.12' (Free Discharge)
↑1=Orifice/Grate (Orifice Controls 0.28 cfs @ 8.36 fps)

Secondary OutFlow Max=0.83 cfs @ 12.36 hrs HW=179.12' (Free Discharge)
↑2=10'-Wide Stone Spillway (Custom Controls 0.83 cfs)

Post-Development

Prepared by SGC Engineering, LLC

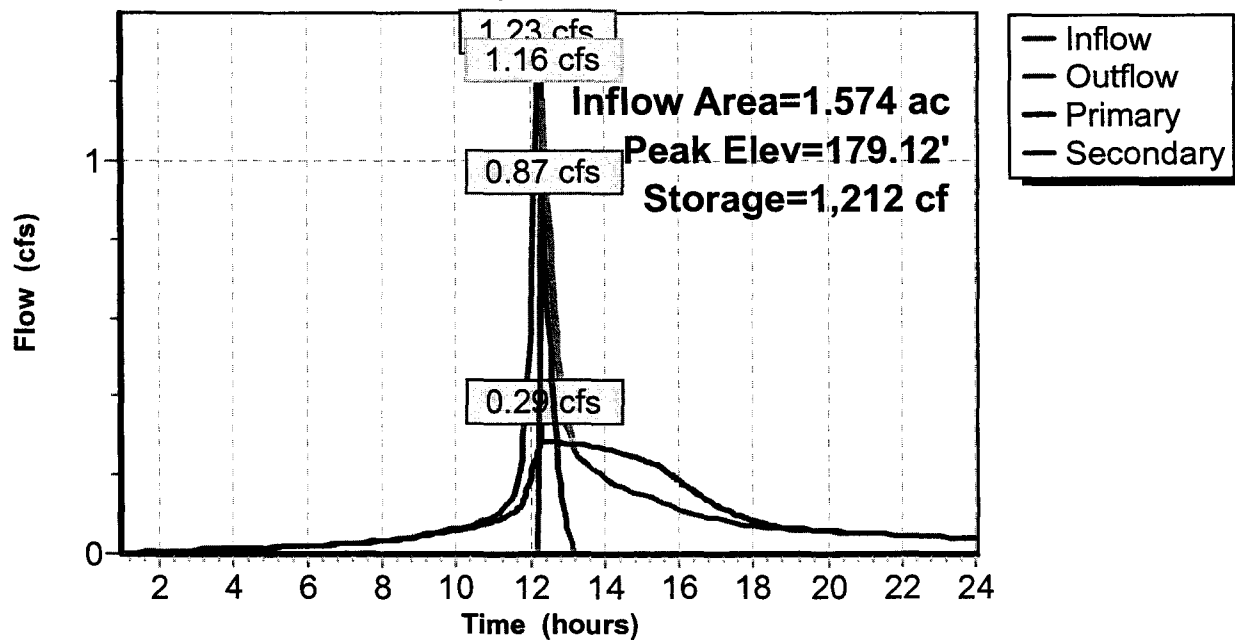
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Type III 24-hr 50-Year Rainfall=5.70"

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Pond 1P1: Pond 1P1

Hydrograph



Post-Development

Type III 24-hr 50-Year Rainfall=5.70"

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Summary for Pond 1P2: Pond 1P2

Inflow Area = 1.895 ac, 25.95% Impervious, Inflow Depth > 1.64" for 50-Year event
Inflow = 2.33 cfs @ 12.28 hrs, Volume= 0.259 af
Outflow = 2.88 cfs @ 12.36 hrs, Volume= 0.257 af, Atten= 0%, Lag= 4.5 min
Primary = 0.29 cfs @ 12.35 hrs, Volume= 0.188 af
Secondary = 2.59 cfs @ 12.36 hrs, Volume= 0.069 af

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 173.17' @ 12.35 hrs Surf.Area= 933 sf Storage= 1,867 cf

Plug-Flow detention time= 55.5 min calculated for 0.257 af (99% of inflow)
Center-of-Mass det. time= 50.4 min (928.1 - 877.7)

Volume	Invert	Avail.Storage	Storage Description
#1	170.00'	2,600 cf	Custom Stage Data (Prismatic) Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
170.00	200	0	0
172.00	625	825	825
174.00	1,150	1,775	2,600

Device	Routing	Invert	Outlet Devices
#1	Primary	170.00'	2.5" Vert. Orifice/Grate C= 0.600
#2	Secondary	173.00'	10'-Wide Stone Spillway
			Head (feet) 0.00 0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50
			Disch. (cfs) 0.000 0.190 0.620 1.260 3.930 7.720 12.630 18.630 25.720 33.890 43.140

Primary OutFlow Max=0.29 cfs @ 12.35 hrs HW=173.17' (Free Discharge)
↑**1=Orifice/Grate** (Orifice Controls 0.29 cfs @ 8.44 fps)

Secondary OutFlow Max=2.36 cfs @ 12.36 hrs HW=173.17' (Free Discharge)
↑**2=10'-Wide Stone Spillway** (Custom Controls 2.36 cfs)

Post-Development

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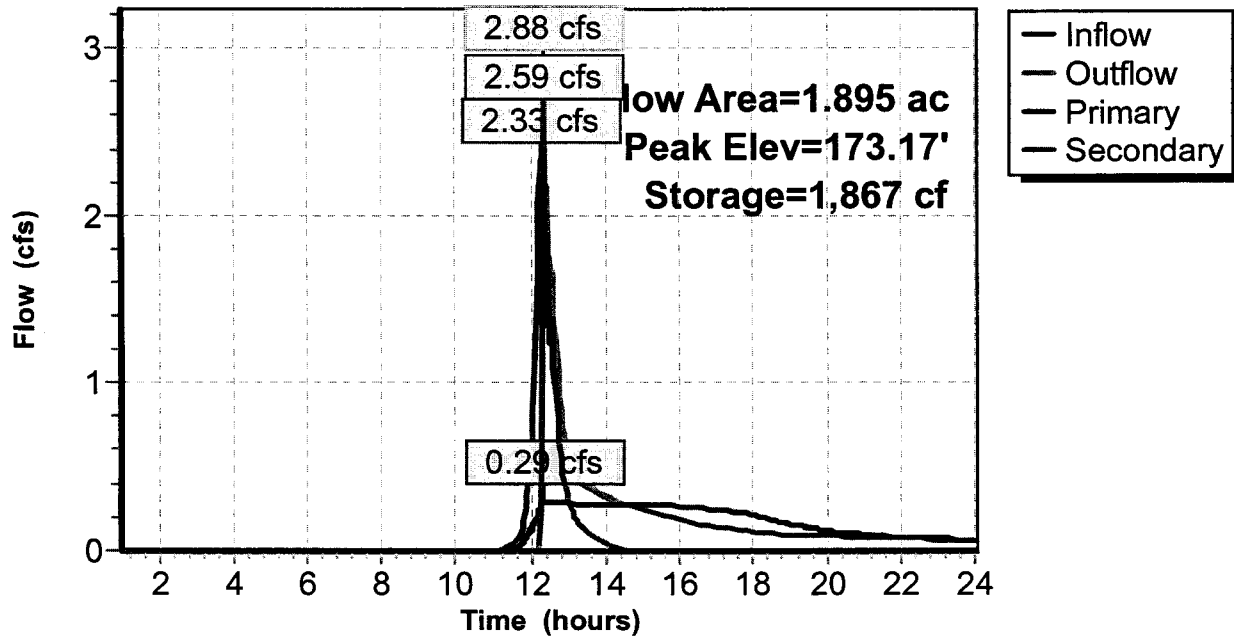
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Type III 24-hr 50-Year Rainfall=5.70"

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Pond 1P2: Pond 1P2

Hydrograph



Post-Development

Type III 24-hr 50-Year Rainfall=5.70"

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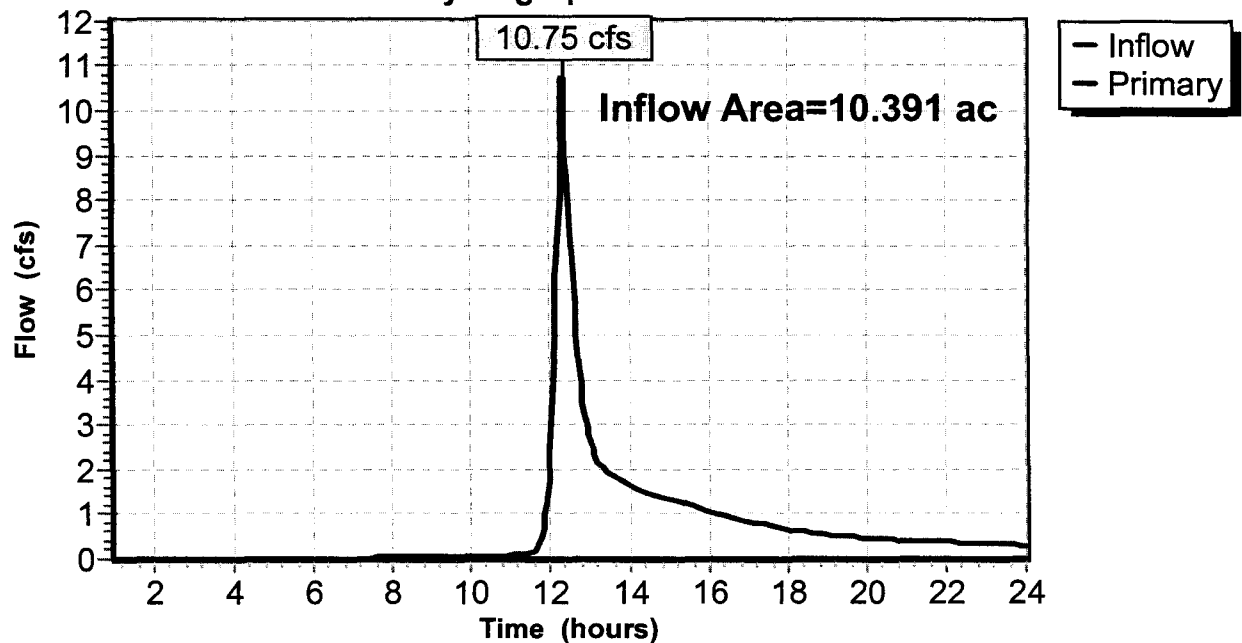
Summary for Link POA 1: Beaver Brook

Inflow Area = 10.391 ac, 7.85% Impervious, Inflow Depth > 1.45" for 50-Year event
Inflow = 10.75 cfs @ 12.35 hrs, Volume= 1.259 af
Primary = 10.75 cfs @ 12.35 hrs, Volume= 1.259 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs

Link POA 1: Beaver Brook

Hydrograph



Post-Development

Type III 24-hr 50-Year Rainfall=5.70"

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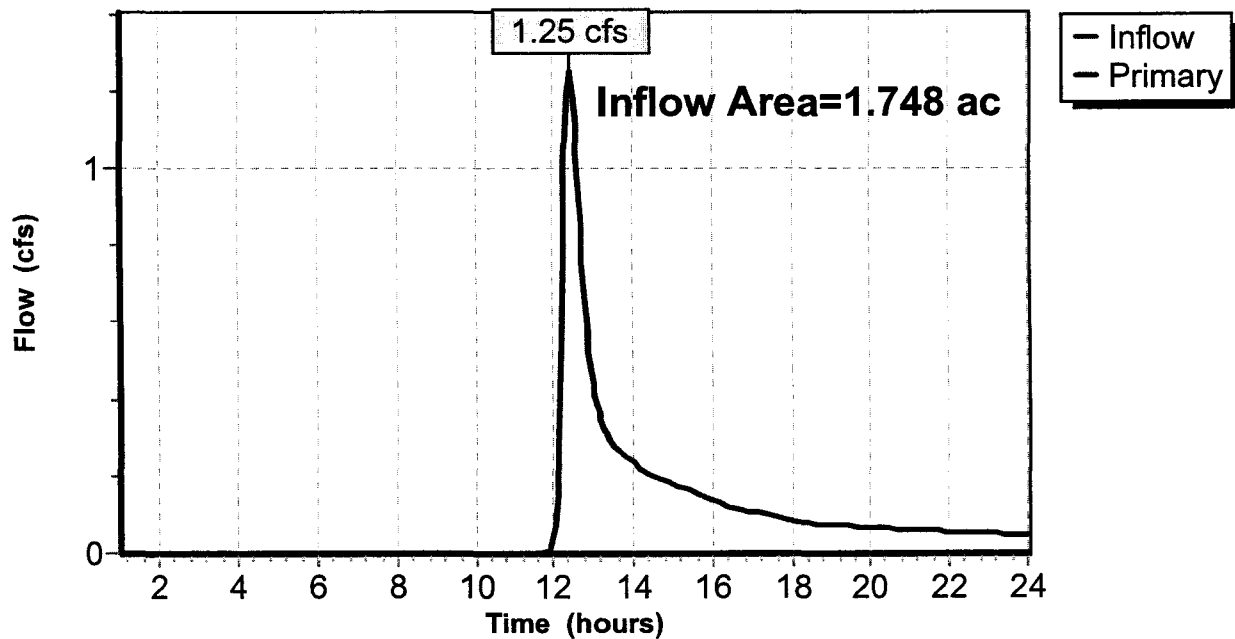
Summary for Link POA 2: Industrial Park Road

Inflow Area = 1.748 ac, 13.13% Impervious, Inflow Depth > 1.12" for 50-Year event
Inflow = 1.25 cfs @ 12.42 hrs, Volume= 0.164 af
Primary = 1.25 cfs @ 12.42 hrs, Volume= 0.164 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs

Link POA 2: Industrial Park Road

Hydrograph



SIZING CALCULATIONS

Stormwater Impoundment Stone Overflow Discharge Calculation

Inputs

D₅₀ 0.50 feet
 Width at Base 10.00 feet
 Sideslopes 3.00 to 1
 Channel Slope, S 0.33 ft/ft

$$n = \frac{Y^{1/8}}{21.6 \cdot \log_{10}(Y/D_{50}) + 14}$$

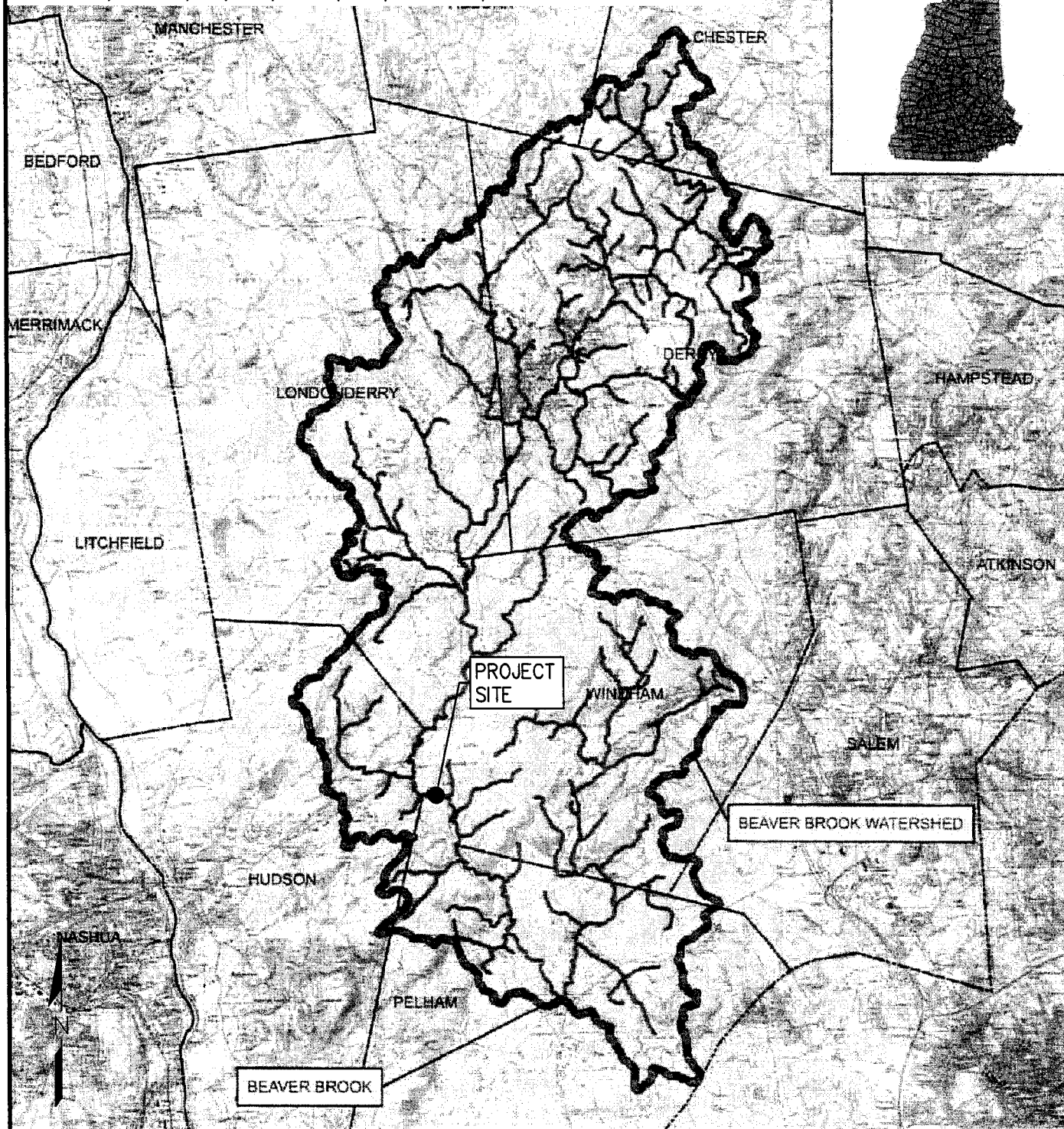
from: "Maine E&S Control BMP's", Section E-6-1

$$Q = \frac{1.486AR^{2/3}S^{1/3}}{n}$$

Depth of Flow, Y, ft	P, ft	A, ft ²	R = A/P, ft	n	Flow Rate, Q, cfs	Velocity, fps
0.05	10.32	0.51	0.05	0.300	0.19	0.38
0.10	10.63	1.03	0.10	0.300	0.62	0.60
0.15	10.95	1.57	0.14	0.292	1.26	0.80
0.20	11.26	2.12	0.19	0.151	3.93	1.85
0.25	11.58	2.69	0.23	0.112	7.72	2.87
0.30	11.90	3.27	0.27	0.093	12.63	3.86
0.35	12.21	3.87	0.32	0.082	18.63	4.82
0.40	12.53	4.48	0.36	0.075	25.72	5.74
0.45	12.85	5.11	0.40	0.070	33.89	6.64
0.50	13.16	5.75	0.44	0.066	43.14	7.50
0.55	13.48	6.41	0.48	0.062	53.47	8.35
0.60	13.79	7.08	0.51	0.060	64.88	9.16
0.65	14.11	7.77	0.55	0.058	77.37	9.96
0.70	14.43	8.47	0.59	0.056	90.94	10.74
0.75	14.74	9.19	0.62	0.054	105.60	11.49
0.80	15.06	9.92	0.66	0.053	121.36	12.23
0.85	15.38	10.67	0.69	0.052	138.21	12.96
0.90	15.69	11.43	0.73	0.051	156.18	13.66
0.95	16.01	12.21	0.76	0.050	175.26	14.36
1.00	16.32	13.00	0.80	0.049	195.47	15.04

APPENDIX

WATERSHED MAP TAKEN FROM "PILOT TMDL APPLICATIONS USING THE IMPERVIOUS COVER METHOD, FIGURE 4-1: BEAVER BROOK WITH WATERSHED BOUNDARY INDICATED", PREPARED BY ENSR INTERNATIONAL, TECHNOLOGY PARK DRIVE, WESTFORD, MA 01886, DATED OCTOBER 2005. AVAILABLE AT:
WWW.EPA.GOV/REGION01/ECO/TMDL/ASSETS/PDFS/ENSR_PILOT/ENSR_PILOT_TMDL_USING_ICM.PDF



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- Electrical Power Systems Engineering

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 Fax: 207-347-8101

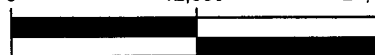
Target Technology Center
 20 Godfrey Drive, Suite 200
 Orono, Maine 04473
 Tel: 207-866-6571
 Fax: 207-866-6501

APPENDIX A

BEAVER BROOK WATERSHED EXHIBIT

DATE: 06-13-08

0 12,000 24,000



SCALE: 1"=12,000'

WATERSHED PLANS